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ABSTRACT

TWO STUDIES WERE MADE OF THE ROCHESTER METHOD OF COMBINING FINGERSPELLING WITH SPEECH AND OF ITS EFFECTS ON DEVELOPMENT OF LANGUAGE AND COMMUNICATION IN PROFOUNDLY, PRELINGUALLY DEAF CHILDREN. A SURVEY TESTED SCHOOL PERFORMANCES OF 200 SUBJECTS FROM SIX RESIDENTIAL SCHOOLS FOR THE DEAF, THREE OF WHICH USED THE ROCHESTER METHOD AND THREE WHICH USED VARIOUS COMBINATIONS OF ORAL AND MANUAL COMMUNICATION METHODS. AN EXPERIMENTAL STUDY COMPARED TWO MATCHED GROUPS OF 16 DEAF CHILDREN, ONE USING THE ROCHESTER AND THE OTHER THE ORAL METHOD, AFTER 4 YEARS ON MEASURES OF LANGUAGE AND COMMUNICATION. THE SURVEY SHOWED CHILDREN USING THE ROCHESTER METHOD WERE SUPERIOR ON MEASURES INVOLVING MEANINGFUL LANGUAGE. THE EXPERIMENTAL STUDY ALSO INDICATED THAT THOSE USING THE ROCHESTER METHOD EXCEEDED THE OTHERS ON READING, WRITTEN LANGUAGE, AND SPEECHREADING ABILITIES. IT WAS THUS CONCLUDED THAT THE ROCHESTER METHOD CAN LEAD TO HIGHER SCHOLASTIC ACHIEVEMENT, NEED NOT DETER ACQUISITION OF ORAL SKILLS, AND IS MORE BENEFICIAL WHEN STARTED WITH YOUNGER CHILDREN. (JB)

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The Influence of FINGERSPELLING on the Development of Language, Communication, and Educational Achievement in Deaf Children

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THE INFLUENCE OF FINGERSPELLING ON THE DEVELOPMENT OF LANGUAGE, COMMUNICATION, AND EDUCATIONAL ACHIEVEMENT IN DEAF CHILDREN

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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INTRODUCTION

The two research studies reported in this monograph are concerned with the effects of the use of fingerspelling in combination with speech (the *Rochester Method*) on the development of language and communication in profoundly, prelingually deaf children. The two studies are presented separately in the report, but are investigations of different aspects of the same problem. One is identified as a survey study and the other as an experimental study. The survey study involved more than 200 subjects from six residential schools for deaf children and youth, three of which were designated as experimental schools and three as comparison schools. The experimental schools were those in which a combination of speech and fingerspelling was systematically used within the classroom with the subjects selected for the project. In the comparison schools, the various combinations of oral and manual communication methods known as the *Combined System* were used. This is the system typically used in most residential schools for deaf children. The project was termed a survey project because no intervention was made in the programs of the schools. The investigator simply administered a battery of tests to the selected subjects in the schools each year for five years and made comparisons between the performances of the subjects in the experimental and comparison schools.

The experimental study involved use of the *Rochester Method* with 16 selected deaf children in a residential school, use of the *Oral Method* with 16 matched deaf children in a comparable residential school, control of the classroom and out-of-class environments of both groups of children for a period of four school years, and comparison of the two groups in the final year of the project on a number of measures of language and communication to determine the comparative effects of the two methods. This study was designated an experimental project because all essential elements were under the control of the investigator: the selection of subjects, the selection of teachers to use the *Rochester Method*, and structuring of the out-of-class environment.

The author interprets the findings of the investigation to show that the appropriate use of fingerspelling can contribute to a certain extent to the development of language, communication, and educational achievement in deaf children. The extent of this contribution and what is meant by the appropriate use of fingerspelling will be considered during the presentation of the research data and the discussion of the results. It is hoped that the reader will go beyond the general conclusion which has just been stated and consider the research data in detail, particularly the specific ways in which the general conclusion is qualified throughout the report. It can be said here that the results of the investigation indicated that the contributions made by fingerspelling were large enough in the opinion of the author to justify its use as a communication method in the education of deaf children. However, the use of fingerspelling with the children in the present study by no means eliminated the great gap which exists in educational development between deaf children and those with normal hearing, nor did it represent what might be termed a significant break-through which could lead to the elimination of this gap. Rather, the use of fingerspelling emerged in the study as a tool that could be utilized in making substantial advances in the education of children who are deaf.

The author has attempted throughout the report to keep data, interpretations of data, and opinion separated. The interpretations and opinions are the author's alone. Other persons might place different interpretations on the data presented or even reject the data because of disagreements with the procedures by which the problem was examined and the data collected. The difficulties inherent in any longitudinal investigation involving behavioral variables generally renders unanimity of interpretation impossible. It is hoped, however, that the present study will supply some factual information concerning the issue of communication methods and that this will lead to further investigations of the problem. An issue which has endured for more than 100 years in the education of deaf children in the United States is not likely to be resolved by polemics. It perhaps cannot be resolved by controlled investigation either, but such investigation is at least likely to provide objective information which could form the basis for more reasonable discussion of the issue than has prevailed in the past.

THE PROBLEM AND ITS HISTORY

In order to provide a frame of reference for understanding the problem under investigation and for interpreting the data which are presented, this chapter is devoted to a presentation of background information on the problem and on the education of deaf children. The chapter includes: (a) a statement and limitation of the problem; (b) definitions of various communication methods used in instructing deaf children; (c) information on the historical antecedents of the problem; (d) a review of research on the effects of various communication methods on the achievement of deaf children; (e) discussion of the various types of educational environments in which deaf children are educated; (f) data on the present educational development of deaf students; and (g) statements of the specific hypotheses to be examined in the study.

The Problem

The purpose of the research projects reported herein was to determine the effects of the *Rochester Method*—the combined use of fingerspelling and speech—on the development of language and communication in deaf children. No attempt was made to perform any evaluation of the use of the language of signs either alone or in combination with other forms of communication. The language of signs makes use of manual signs and gestures to convey concepts as contrasted to the use of words for the same purpose. Fingerspelling is not a language but a means of communicating information through the use of hand and finger positions representing the letters of the written alphabet of the language. There appears to be some agreement that the language of signs contains all the elements of a formal language but differs from English in symbolic and syntactical structure at least (Stokoe, 1960). This raises the question as to whether it should be used in educating deaf children who must function in a culture where English is the dominant language. Such a question is worthy of investigation but was not the purpose of the present study which was concerned only with the use of fingerspelling in combination with speech as a method of instructing deaf children.

Definitions of Communication Methods

Three methods of communication are widely used in the United States in educating deaf children: the *Oral Method;* the *Rochester Method;* and the *Simultaneous Method.*

(a) *The Oral Method.* In this method, as practiced in its pure form, the deaf child is instructed through speech and writing. He, in turn, communicates through speech, speechreading, writing, and reading. This method also is known as the *German Method* because of its original widespread use in Germany through the work of Samuel Heinicke in the 18th century.

(b) *The Rochester Method.* This method also uses speech, speechreading, writing, and reading as means of communication between students and instructor but adds fingerspelling as an additional communication avenue.

(c) *The Simultaneous Method.* In the *Simultaneous Method,* communication and instruction are conducted in the same manner as in the

Rochester Method with the addition of manual signs. This method also is known as the *French Method* due to its original use in France through the work of the Abbé Charles Michel de l'Épée in the 18th century.

In all three methods, auditory training and amplification are used in varying degrees, with the greatest emphasis usually being in the schools which are strictly oral.

These brief descriptions are simplifications of the methods as they actually are practiced. The methods are rarely used in pure form, with a few notable exceptions such as the *Oral Method* as used in some private residential schools. Some of the departures which are commonly made from the pure forms of the methods are important in interpreting research relating to these methods. For example, the *Simultaneous Method* supposedly requires strict adherence to English word order, with the words being spoken and also presented simultaneously through signs and fingerspelling. In actual practice, departures from appropriate word order are common, particularly in the omission of certain types of words. In the *Oral Method*, the child should constantly be exposed to speech both in and out of the classroom. In actual practice, many schools which have good oral programs within the classroom permit manual communication in various forms to be used outside of class. In the past, the *Rochester Method* has rarely been used in its pure form other than in the Rochester School for the Deaf. In some schools where this method has been attempted, the use of signs along with the fingerspelling often becomes so common that the method in use could more appropriately be termed the *Simultaneous Method*.

Historical Antecedents of the Problem

The first recorded person to undertake the teaching of deaf students was Pedro Ponce DeLeon, a Spanish monk who was born in 1520 and died in 1584. He is reputed to have educated the deaf children of several noble families in Spain in order that the children might become legally qualified to inherit their families' estates. The few records that exist of the work of Ponce DeLeon indicate that he first taught reading and writing by associating objects with the printed word and then introduced speech by associating movements of the vocal organs with the printed characters. Unfortunately, his work died with him and we have no direct or detailed records of his methods and results (Bender, 1960).

Shortly following the work of Ponce DeLeon, the education of the deaf children of several Spanish noblemen was undertaken by Juan Martin Pablo Bonet. Bonet advocated the teaching of a one-handed manual alphabet as the first step in the education of a deaf child and presented his methods in the first book published on the education of deaf persons, *Simplification of Sounds and the Art of Teaching the Dumb to Speak*, which appeared in 1620 (Bender, 1960). Finger and hand positions representing the letters of the alphabet were associated with the printed letters so that the child was learning to read the printed word at the same time as learning fingerspelling. Following this, the child was taught speech by associating positions and movements of the vocal organs with the printed and fingerspelled symbols.

The one-handed manual alphabet advocated by Bonet in 1620 is essentially the same as that in use in the United States today. In fact, the educational method of associating fingerspelling, speech, and the printed word which was used by Bonet is similar to the *Rochester Method* used in this country and which is the focus of the present report. This method also has gained popularity in the Soviet Union during the past 10 to 15 years under the name of neo-oralism. It can thus be seen that this most recently advocated method for teaching deaf students in the United States and in Russia has its roots in the work of Bonet almost 350 years ago.

The next major development in communication methods in instructing deaf students came with the work of the Abbé Charles Michel de l'Épée in Paris in the mid-eighteenth century. De l'Épée founded the first public school for deaf children in Paris in 1755 and from its beginning the language of signs was used as the chief method of instruction. De l'Épée was convinced that the language of signs was the natural language of deaf people and that their education should be based on it. He recognized, however, that the signs and gestures normally used by deaf people in his time as a means of communication were too crude and restricted to serve as an educational tool, and so set himself the task of refining and expanding these signs in an attempt to develop them into a full language. The elaborate system of signs which he developed and the methods by which he used them as a basis for educating deaf persons are described in two books which he wrote: *Instruction of Deaf and Dumb by Means of Methodical Signs;* and *The True Manner of Instructing the Deaf and Dumb, Confirmed by Long Experience* (Bender, 1960).

Like Bonet, de l'Épée began instruction by teaching a manual alphabet. Objects then were associated with the printed word and with the word spelled on the fingers. Teaching proceeded to the use of signs to denote objects and ideas, signs being faster than fingerspelling and, according to de l'Épée, the mother tongue of deaf people and their natural vehicle for thought and the expression of ideas. Speech and lipreading also were taught but were regarded by de l'Épée as not worth the time and effort required to teach them.

While the Abbé de l'Épée in France was becoming known as the father of the *French Method* (the language of signs), Samuel Heinicke in Germany was becoming known as the father of the *German Method* (the oral method). Heinicke was born about 1727 and died in 1790, thus his lifetime was contemporary with that of de l'Épée. He was a strong proponent of teaching deaf children through speech and speech reading, considered spoken language to be the foundation on which their education should be built, and believed that thought was possible only through oral language. Heinicke was firmly opposed to manual communication believing it to be harmful to the educational progress of deaf persons and engaged for many years in a bitter controversy with de l'Épée on the topic. The controversy never was resolved and is the basis for the controversy which exists at the present time in the use of the various methods of communication in instructing deaf children.

The language of signs was introduced to the United States by Thomas Hopkins Gallaudet, the founder of the first school for deaf children in this country in Hartford, Connecticut, in 1817. This school, originally named the American Asylum for the Education and Instruction of the Deaf and Dumb, still exists in Hartford as the American School for the Deaf. Gallaudet had become interested in 1817 in the education of deaf children through his attempts to teach Alice Cogswell, the deaf daughter of a neighbor, Dr. Mason Fitch Cogswell, in Hartford, Connecticut. In 1815, Dr. Cogswell persuaded a group of friends and neighbors to contribute sufficient funds to send Gallaudet to Europe to study methods of educating deaf children with a goal of eventually establishing a school for the deaf in the United States.

Gallaudet went to England to a school which had first been established in Edinburgh by Thomas Braidwood and then moved by him to London. This school was founded on purely oral methods which Braidwood had evolved during his early teaching of a number of deaf children. As was the practice at that time, Braidwood kept his methods secret and taught them only to a selected few disciples. It was Gallaudet's intention to spend some time learning the methods used by Braidwood and then to proceed to Paris to study the methods which had been initiated by de l'Épée. This plan did not meet with the approval of Braidwood, and Gallaudet was unable to obtain the information which he sought concerning the methods used in Braidwood's school.

While Gallaudet was in England, the Abbé Sicard arrived on a lecture tour in London with two of his most famous deaf pupils, Jean Massieu and Laurent Clerc. The Abbé Roch Ambroise Cucurron Sicard had succeeded the Abbé de l'Épée as head of the school in Paris upon the death of de l'Épée in 1789. Gallaudet was very impressed with the performance of the two deaf pupils, Jean Massieu and Laurent Clerc, and decided to journey to Paris with Sicard to study the methods used in the Paris school. After studying the *French Method* for a few months, Gallaudet returned to America, bringing with him Laurent Clerc, who was destined to be the first deaf teacher of deaf persons in the United States.

There has been much speculation as to what direction the education of deaf persons in the United States might have taken if the Braidwoods had been less secretive about their methods and permitted Gallaudet to study them. The speculations are interesting but fruitless. The fact remains that the *French Method* of manual communication was the first method used in instructing deaf children in the United States and was the predominant method for more than 50 years before oral schools were established to challenge it. Gallaudet's study with Sicard also resulted in the establishment of the tradition of the deaf teacher. Since the employment of Laurent Clerc at the old American Asylum for the Education and Instruction of the Deaf and Dumb, many hundreds of deaf persons have themselves taught deaf children, and deaf teachers are now employed in most state residential schools in this country.

During the 50 years following the establishment of the school at Hartford, residential schools for deaf children and youth were established in many states. Manual methods of instruction were used almost exclusively in these schools in the education of the students. This was an unbroken pattern until the establishment of the Clarke School for the Deaf in 1867 in Northampton, Massachusetts. The Clarke School used the *German Method* of oral instruction only and to this day is one of the foremost proponents of the method.

The *French Method* now was challenged by the *German Method* in the United States. Gradually, most schools for the deaf began to incorporate oral methods of teaching in their curricula. The system of state schools, however, which had spread throughout the United States, did not become completely oral. While oral classes were instituted for most children in their first years in school, manual classes were provided in the later years for those children who seemed not to benefit from oral instruction. This combination of the *German Method* and the *French Method* led to what is now called the *Combined System*, where oral and non-oral classes are available within a single school. This is the predominant system used in state public residential schools in the United States today.

One other important type of instruction involving manual communication developed in the Rochester School for the Deaf and has become known popularly as the *Rochester Method*. This is the combined use of speech and fingerspelling in instruction. In this method, the teacher speaks and also fingerspells every word so that the student receives simultaneous reception through reading lips and reading the fingerspelled version.

This method was established in the Rochester School in 1878 by Zenos Westervelt, who was superintendent of the school at that time. It was used in the Rochester School with all children until about the mid-1940's, when the use of fingerspelling was abandoned in the primary grades. Since that time, the method has been used in the classroom only from the time the children enter the intermediate department of the school, which is generally at about the age of 12 or 13 years. The abandonment of the method in the primary grades apparently was due to the feeling on the part of parents and other persons connected with the school that the developments in amplification and the use of residual hearing which resulted from work with hearing-impaired war casualties could best be utilized by young deaf children if no manual means of communication were involved in their instruction. No body of evidence ever has been presented to support this point of view.

The next development in the use of the *Rochester Method* took place with the establishment of the California School for the Deaf at Riverside, California, in 1951. Since the time the school was established, the *Rochester Method* has been used in the classroom in the same way in which it is used in the Rochester School. That is, the method is not generally used with children in the primary grades but is begun when the children enter the intermediate department of the school, which is at about the age of 12 or 13 years.

Another development in the use of the *Rochester Method* took place in 1958 when the New Mexico School for the Deaf began using combined speech and fingerspelling with children from the time the children entered school. In New Mexico, children may legally enter the state school for the deaf at the age of three; however, in practice most children do not enter until the age of five or six years. Until the present study began in 1963, the New Mexico School for the Deaf was the only school in the United States using the *Rochester Method* with deaf children in the primary grades. The Rochester School for the Deaf, the California School for the Deaf at Riverside, and the New Mexico School for the Deaf are the three experimental schools used in the survey study reported in this document.

Research on Communication Methods

Surprisingly, the often bitter controversy which has centered on the use of the various methods of communication in instructing deaf children has produced very little research. While there is considerable literature debating the merits of the various communication methods, there is a dearth of data on the results produced by use of the methods. Much of the literature on the use of manual communication consists of such descriptive articles as Scouten's (1960), which describes the use of the *Rochester Method* and makes a plea for its use in the classroom with deaf children, or support for the use of manual communication by individuals with only a superficial knowledge of the problems of educating deaf children, who apparently believe that the use of manual communication will correct most of the inadequacies of the educational system (Kohl, 1967). The few studies which have supplied some direct or indirect evidence on the effects of the use of manual communication will be reviewed here.

One of the first studies to examine the results achieved by various methods of communication in instructing deaf children was reported by Johnson (1948). The study was conducted with students in the Illinois School for the Deaf, which at that time had separate Acoustic, Oral, and Manual Departments for instruction. All children entering the school began in the Oral Department, where only oral methods of instruction were used. During the first few years in this department the children were observed closely, and those children who seemed to benefit from the use of amplification were transferred to the Acoustic Department, where emphasis was placed on the use of residual hearing. Other students who seemed not to benefit from instruction in the Oral Department, and who had little usable residual hearing, were transferred to the Manual Department, where instruction was in the *Simultaneous Method* of speech, the language of signs, and fingerspelling. Children who did not have considerable residual hearing but who seemed to be progressing satisfactorily by oral methods of instruction were retained within the Oral Department.

It will be obvious that the division of children into oral, acoustic, and manual groups after a trial period in an oral program probably introduced a selective factor which could not be controlled in making comparisons among the groups; nevertheless, a comparison of the achievements in the three departments would seem to be worthwhile and was undertaken by Johnson in 1948. She compared the results of tests of communication in reading, speech-hearing, lipreading, hearing plus lipreading, fingerspelling, and the language of signs combined with fingerspelling for pupils from the Acoustic, the Oral, and the Manual Departments.

After matching groups of children from each of the three departments on a number of relevant variables and comparing them on tests of the several communication methods, Johnson concluded: "When pupils in this school for the deaf are communicated with as a group, there appear to be only two methods of communication which could be used with any reasonable degree of accuracy. Fingerspelling with a mean of 74 percent and reading with a mean of 72 percent of normal achievement afford fairly acceptable methods. The other media of communication tested cannot be considered acceptable for the group as a whole." Johnson further stated that inasmuch as the ability of the oral pupils in her study to understand language through lipreading was so inferior to their ability to understand fingerspelled language, it might be advisable in the interests of increased academic achievement to replace lipreading with fingerspelling as the classroom method of communication for all those oral pupils without usable hearing acuity, a history of hearing experience, or high lipreading scores. It should be pointed out that students in the Illinois School, as students in most other public state residential schools, are free to use manual communication in any form outside of the classroom. This would account, of course, for the pupils in the oral and acoustic departments being skilled in the use of fingerspelling and the language of signs.

In 1960, Morkovin reported in the *Volta Review* on the Russian experiments with neo-oralism, which is similar to the *Rochester Method* —a combination of speech and fingerspelling. Morkovin's translations and interpretations of the Russian literature indicate that the Russians, in working with young deaf children over a period of several years starting at the age of two, claimed to have succeeded in giving the children vocabularies of several thousand words by the time they were six years old. At this age, few deaf children in the United States would have vocabularies of even several hundred words. The Russians also claimed that the use of fingerspelling fostered the development of speech and speechreading and that the deaf children in their experiments eventually were able to abandon fingerspelling and rely solely on speech and speechreading for communication.

The author of the present study has had many of the publications in the Russian literature on fingerspelling translated and has been able to find very little information on two important points. First, there is no good indication of how vocabulary actually was measured in the five- and six-year-old deaf children who reputedly had achieved vocabularies of two to four thousand words. Second, only limited information could be found concerning what other changes might have taken place in the education of deaf children in the Soviet Union at the time fingerspelling was initiated.

So far as the author has been able to determine, the assessment of vocabulary was undertaken by means which would not be considered particularly rigid by investigators in the United States. Apparently, the vocabulary counts which were given by Morkovin (1960) were estimates made by the teachers of the numbers of words which they thought the children had learned. Also, a number of important changes apparently took place in the curriculum for deaf children at the same time fingerspelling was initiated. It apparently was at this time that preschools were established for deaf children at the age of two years. Considerable revisions also were made in the curriculum for the teaching of language and speech. Because of these changes it is not possible to determine how much of any increased achievement on the part of the children was due to the use of fingerspelling, to the earlier age of admission, or to changes in the curriculum. As indicated earlier, it is not even known just how reliable the vocabulary counts for the children are. It should be added, however, that a number of visitors from the United States to the classes for deaf children in the Soviet Union where fingerspelling is being used have been quite impressed with the apparent level of achievement of the children and with their language facility.

In 1961 the Council for Exceptional Children published a monograph by Quigley and Frisina which contains some data relating to the influence of manual communication on the achievement of deaf children. The investigation was concerned with the effects of living in residential schools on the psychoeducational development of deaf students. The problem was investigated by comparing the achievement of a group of day students in six residential schools with a matched group of boarding students within the same schools. The results showed that the major differences between the two groups were in speech and speechreading where the day students had significantly higher scores than the boarding students. In seeking an explanation for these findings, Quigley and Frisina (1961) compared the data on 16 of the day students who had deaf parents with the data on 70 day students who had no deaf relatives in their immediate families. The investigators found that the day students with deaf parents had inferior speech scores as compared to day students with hearing parents. However, the children with deaf parents were significantly superior in vocabulary and fingerspelling and were also superior in educational achievement although this did not quite reach statistical significance. The authors reasoned that the day students with deaf parents likely were exposed to manual communication at home and had been exposed to it during early childhood. They, therefore, interpreted the findings as showing that the exposure to manual communication at an early age among children with deaf parents resulted in superior language development. The inferior development in speech intelligibility was interpreted as being due to a lack of oral stimulation in the home environment.

A more extensive investigation of the influence of early manual communication on the language development of deaf children was conducted by Stuckless and Birch (1966). These investigators compared two matched groups of deaf children, with one group having been exposed to manual communication early in life primarily because of having deaf parents and the other group not having had early exposure to manual communication. The findings showed that the group with early manual communication exposure was superior to the control group in reading, written language, and speechreading, and was comparable to the control group in speech intelligibility and psychosocial development. In general, the findings supported and expanded those reported by Quigley and Frisina (1961).

Hester (1963) has reported some results from the experimentation with fingerspelling in the New Mexico School for the Deaf. He made various comparisons of reading levels between children who had been taught through the combined use of fingerspelling and speech for a number of years and selected children who had been in the school prior to the time when fingerspelling was initiated. His results showed that those who had been exposed to fingerspelling from the time they began in the New Mexico School for the Deaf had higher reading scores than the children in the school who had not been exposed to the fingerspelling method. In evaluating these findings, one must bear in mind the difference of several years in time between the administration of tests to the two groups of children and other possible factors which might have differed between the groups and could not be controlled in the study.

A recent doctoral dissertation by Meadow (1967) investigated the development of self-concept in two groups of deaf students in the California School for the Deaf at Berkeley, California. One group consisted of students with deaf parents who had been exposed to manual communication in the home during early childhood. The other group consisted of students who had hearing parents and who had not been exposed to manual communication in early childhood. Meadow found that the group of deaf children with deaf parents and early exposure to manual communication had better development of self-concept and better psychosocial development than did the group of children with hearing parents. The group of children with deaf parents also had significantly higher academic achievement and reading achievement, and were superior in written language, fingerspelling, and the use of the language of signs. The ratings of lipreading and speech ability obtained from teachers and counselors were equal for the two groups. These findings supported and expanded those of Quigley and Frisina (1961) and Stuckless and Birch (1966).

While investigations of the effects of fingerspelling on the achievement of deaf children are few, it can be seen that there is considerable agreement in the results of the studies which have been reviewed. There seems to be agreement that the use of manual communication has a beneficial effect on development of those variables which are related to meaningful language. There is some doubt as to the effects of such manual communication upon speech intelligibility and there are conflicting findings concerning the effects upon the emotional adjustment of the children.

Educational Environments

The different methods of communication used in instruction with deaf children are closely related to the three major types of educational environments for such children in the United States: residential schools, day schools, and day classes. Residential schools, whether they be public, private, or denominational, provide both educational facilities and boarding facilities for their students. Day schools generally provide segregated educational facilities except for play and vocational training. In these schools, however, boarding facilities are not provided since the children return home after school hours. Day classes usually are part of regular public school systems located within schools for normal hearing children and attempt in varying degrees to integrate deaf pupils in classes for normal hearing students.

In general, day schools and day classes use and permit to be used only oral methods of communication, although in recent years a few day programs have begun to use fingerspelling with some children. Only oral methods are used also in a number of private and denominational schools. Most public residential schools, however, use what is termed the *Combined System.* In schools using the *Combined System,* children are instructed by oral methods during the first several years in school; however, other classes in which manual methods of communication may be employed are provided for those children who appear not to make satisfactory progress with the oral method.

Quigley and Frisina (1961) showed that the type of educational environment has an effect on the development of various types of communication in the deaf child. In order to examine the possible effects of institutionalization on the development of deaf children, they compared a group of day students within residential schools with a matched group of boarding students in the same schools. The major difference between the groups was that the boarding students resided in the school after class hours whereas day students went home. In comparing the two groups on a number of experimental variables, the investigators found that the day students had significantly higher scores in speech and speechreading than the boarding students. These differences were found not only for the total subjects within the two groups but also for the day students as compared to the boarding students in each of the six residential schools which participated in the study. The investigation also showed that the day students, while superior to the boarding students in speech and speechreading skills, were equal to the boarding students in their scores on a test of ability to read fingerspelling. After making a sub-analysis comparing day students with deaf parents to day students with no deaf relatives (as discussed in an earlier section of this chapter) the investigators concluded that the superior scores of the day students on speech and speechreading tests were due to the greater oralness of the environment to which they were exposed. It was reasoned that the day students, having to function after class hours mostly with hearing persons who were not skilled in the use of manual communication, would have to use their oral skills to a greater extent than the boarding students.

While the findings of the study related only to day students and boarding students in residential schools, it is reasonable to assume that similar differences in oral skills would be found between students in day schools and day classes and boarding students in residential schools. Because of this, it was decided in the present study to limit the schools under investigation to residential schools only. It was felt that using comparison groups from day schools or day classes would introduce some factors which could not be subjected to experimental control. It should also be borne in mind that since all of the schools in the present study are public residential schools, the out-of-class environment is similar to that of the residential schools in the study by Quigley and Frisina (1961). That is, communication among children out of class and between the children and other school personnel would usually be in the language of signs and fingerspelling with very little oral communication, at least on the part of the student.

Educational Development of Deaf Students

In interpreting the findings of the present project, one must not only keep in mind previous data in the literature on the effects of various communication methods and the effects of various types of educational environments on communication development, but also the general educational achievement level which is typical of deaf childen in schools in the United States. The low level of such achievement as measured by tests standardized on the general school population is usually surprising to persons who have not been involved in the education of deaf children. There is a considerable amount of data in the literature which gives information on the achievement level of deaf children on various educational variables. A few of the more recent studies will be cited here. They are cited not as criticism of the existing school system for deaf children but to give the reader a frame of reference against which to compare and evaluate the findings of the present project.

The accomplishments of the educational system for deaf children have been summarized in the opening statement of the report of the Babbidge Committee titled *Education of the Deaf* (1965): "The American people have no reason to be satisfied with their limited success in educating deaf children and preparing them for full participation in our society." This report includes data from a survey made for the Babbidge

Committee of 920 deaf students reported leaving public residential schools in the school year 1963-64. At no age was the median grade as high as the seventh grade despite the fact that most of those included in the survey were at least of high school leaving age. A sub-analysis for the 365 students in the group who received academic diplomas revealed that the median achievement level by age ranged from something less than seventh grade to something less than ninth grade. In fact, of the total 920 students reported leaving public residential schools in the 1963-64 school year, no more than a half dozen or so had achieved the twelfth grade level on a standard achievement test.

Hester (1963) reported the findings of a survey of 42 day classes and day schools and 80 residential schools, both public and private, in the United States to determine the achievement level of school leavers during the year 1961-62. Nine day classes and day schools and 55 residential schools returned information on 501 graduates and 603 non-graduates all 16 years of age or older. The grade equivalent scores reported in the study were obtained by the various schools on the Stanford Achievement Test, the Metropolitan Achievement Test, and the California Achievement Test. On the total test grade equivalent scores, the graduates showed a range of 3.1 to 12.8 with median at 8.1, and the non-graduates showed a range of .9 to 10.5 with the median at 4.7 A study by Boatner (1965) of 99 residential and day schools brought returns from 88 showing that at least 60 percent of the 1,277 pupils age 16 years or older leaving those schools in June, 1964, had an achievement level of 5.3 or lower and that only 70, or about 5 percent had attained at tenth grade level or higher.

The low performance of deaf children on standard educational achievement tests does not tell the full story of the difficulty in educating deaf children. It is commonly known among persons involved in the education of deaf children that the level of the students on reading tests is usually one or two years lower than their level on an educational achievement test. This means that most deaf children graduate or terminate from educational programs with a reading level of approximately fourth grade or lower. Two studies will be cited to support this contention. A study by Furth (1966) reported data adapted from a comprehensive survey of the reading ability of deaf children conducted by Wrightstone, Aronow, and Moskowitz (1963). Norms for deaf children were obtained by administering the *Metropolitan Elementary Reading Test, Test II: Reading,* to a large and representative sample of deaf children in schools in the United States. The data showed that between the ages of 11 and 16 the mean grade equivalent scores of the deaf students advanced only from grade 2.7 to grade 3.5 or less than one grade level. The data also revealed that by the age of 16 only about 12 percent of the students in the sample were scoring reading levels of better than grade 4.9. A study by Rosenstein and Lerman (1965) of former students of the Lexington School for the Deaf reported data on the reading ability of the subjects during their last year at the Lexington School. The average reading level for these former students was approximately fifth grade. The mean IQ reported for the students was approximately 104 indicating that they were typical deaf students in this respect.

While the educational achievement scores of deaf children do not indicate the full severity of their language deficit, neither do the data on reading achievement levels. The best indicator of a deaf child's language functioning is his ability to write connected English discourse. A number of studies have been conducted of the written language of deaf children but most of these studies have been unable to quantify written language in such a way that a single indicator of written language goodness could be derived. Most persons familiar with the education of deaf children, however, would agree that the written language of a deaf child reading at a certain grade level would likely be inferior in many respects to the written language of a normal hearing child with a comparable reading level. One study of this important problem was conducted by Moores in an unpublished doctoral dissertation (1967).

Moores investigated the relationship between "Cloze" procedures and reading achievement scores in deaf and normal hearing students. In the "Cloze" procedure, the subject is presented with a written passage of a certain length from which every nth word has been eliminated, and the subject is requested to supply the most appropriate word for each blank space in the story. Moores reasoned that the "Cloze" technique possesses greater sensitivity to morphological, syntactic, and semantic abilities than reading tests and should be capable of differentiating between groups of deaf and normal hearing students matched on the basis of reading achievement scores. It was hypothesized that the normal hearing students when compared to the deaf students would exhibit superior grammatical and semantic proficiency as measured by the "Cloze" technique even though the two groups were matched on reading achievement scores.

The experimental group consisted of 37 students at a school for the deaf, and the control group consisted of 37 elementary school students with normal hearing. The average age of the experimental group was 16 years 9 months and their mean grade reading achievement was 4.77. The control group of fourth and fifth grade students had an average age of 9 years and 10 months and a mean grade level achievement score of 4.84. Three passages of approximately 250 words were chosen from fourth, sixth, and eighth grade reading textbooks, and every fifth word was deleted from each passage. The subjects were instructed to fill in the blank spaces with the most appropriate words. Responses were scored for each passage for (a) verbatim reproduction—replacing the exact word deleted from the text; (b) form class reproduction—supplying a word from the same grammatical class as the original word; and (c) verbatim given form class reproduction—the percentage of correct verbatim responses given correct form class responses. The important measures are (a) form class reproduction, which is a measure of the morphological, syntactic, or grammatical ability of the subjects, and (b) verbatim given form class reproduction, which is a measure of semantic or vocabulary sufficiency.

Figure 1, adapted from Moores' data, shows the percent of correct form class responses of the matched deaf and normal hearing groups for the passages of fourth, sixth and eighth grade levels of difficulty. It will be noted that at each level of difficulty the control group attained higher scores than the deaf subjects. Analysis revealed that these differences were statistically significant at each difficulty level. Since high ratings on form class reproduction suggest a sensitivity to and familiarity with the morphological and syntactic constructions of a particular passage, the results of the comparisons between the deaf and normal hearing subjects indicated that the deaf subjects were inferior to the control group in these capacities in spite of the two groups being equated on reading achievement level.

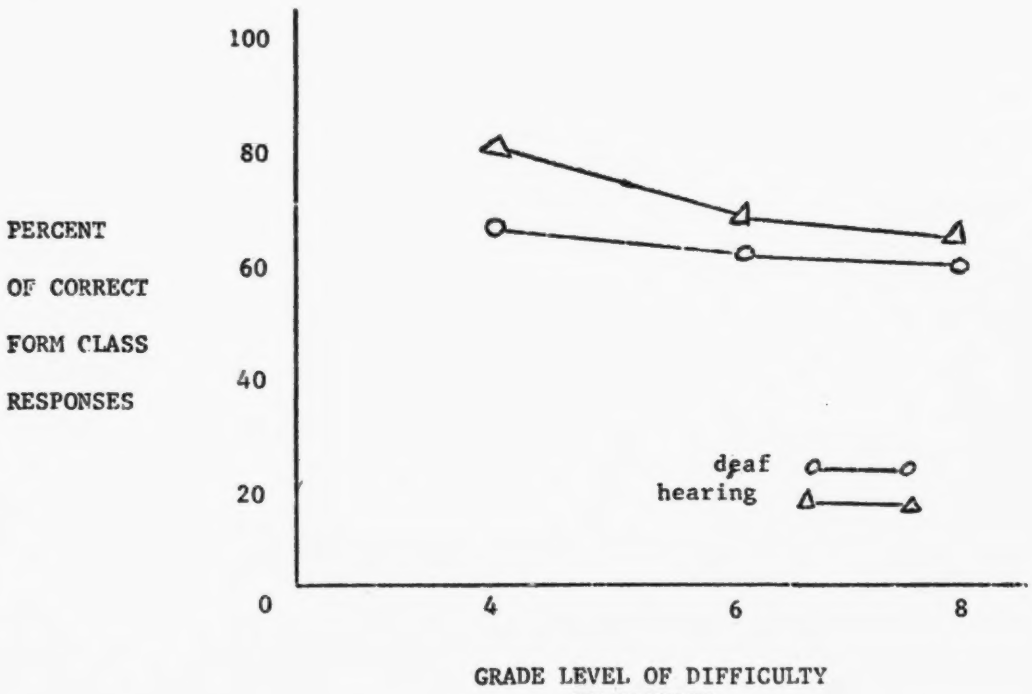

Fig. 1. Percent of Correct Form Class Responses of Deaf and Hearing Groups for Passages of Fourth, Sixth, and Eighth Grade Levels of Difficulty.

Figure 2, adapted from Moores' data, presents the verbatim given form class reproductions of the two groups for the three levels of difficulty. Again, statistically significant differences were found in favor of the subjects with normal hearing. By scoring subjects on the basis of verbatim responses given correct form class reproduction, it was possible to hold the factor of morphological and syntactic ability constant and through this control mechanism to compare the relative semantic strengths of the two groups. The superior performance of the control group on this measure, therefore, indicated a higher level of semantic functioning for this group than for the group of deaf students, even when linguistic differences had been neutralized.

The study by Moores (1967) has a number of important implications for the education of deaf children; however, its major interest for the present investigation is to show that the standardized reading achievement tests commonly used with deaf children give an inflated measure of their actual language ability. Thus, the actual language performance of deaf children on standardized tests as cited throughout the literature is an inflated estimate of what the situation actually is.

These data on "Cloze" procedures, reading achievement level, and educational achievement level are cited simply to show how difficult is the process of educating a deaf child. The data in the present study must be evaluated against this background of low language achievement for deaf children in general. While many of the differences in favor of

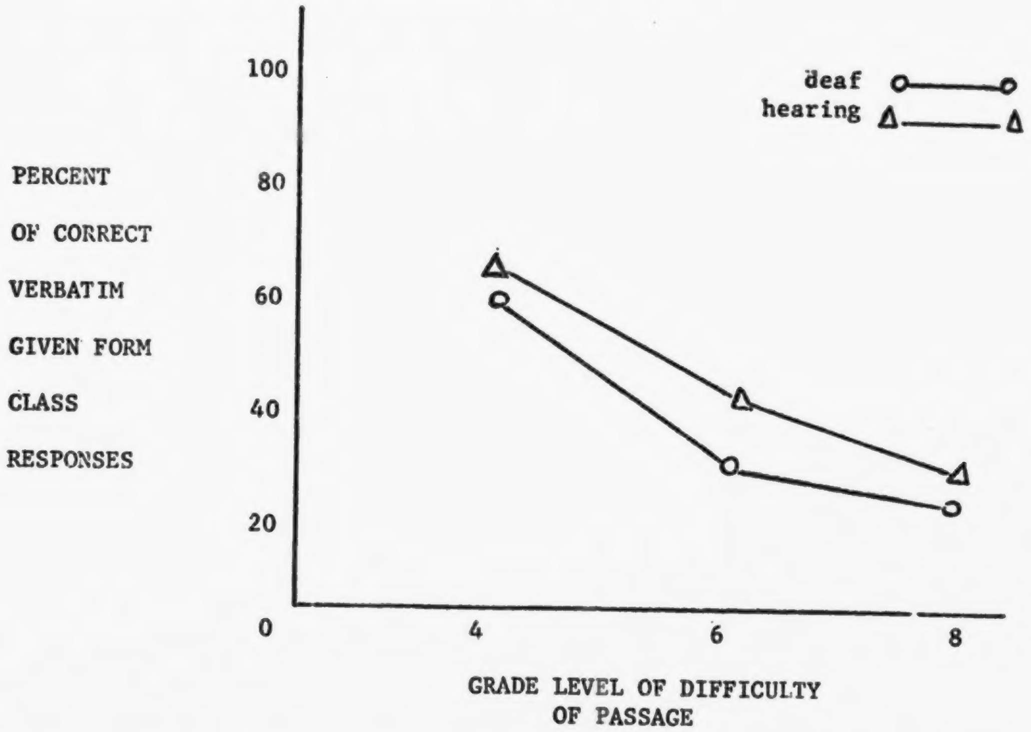

Fig. 2. Percent of Correct Verbatim Given Form Class Scores of Deaf and Hearing Groups for Passages of Fourth, Sixth, and Eighth Grade Levels of Difficulty.

the fingerspelling groups reported in the present study were statistically significant, the actual differences in terms of grade level often were not very large. DiCarlo (1967) presented a critique of the study by Stuckless and Birch (1966) on this particular point. He emphasized that the differences found in favor of the group exposed to early manual communication in the Stuckless and Birch study while statistically significant were only in the order of about half a grade level in terms of reading achievement with similar small differences existing in the other measures in the study. While this is true, the author of the present study would contend that major breakthroughs in the education of deaf children are just as unlikely to occur as they are in any other aspect of education and that what we are more likely to find through the use of various improved techniques is a number of small significant advances which hopefully will eventually add up to a significant increment of achievement for the deaf child.

Statement of Hypotheses

In studying the behavioral effects resulting from instructing deaf students by a combination of speech and fingerspelling, it would be desirable to assess the effects on the total development of the individual since it is possible that the use of fingerspelling might be beneficial in some respects (*e.g.*, in the development of reading and written language) and detrimental in others (*e.g.*, in the development of speechreading and speech intelligibility). We do not yet have, however, the ability to measure all of the behavioral variables relevant to the problem under investigation. This is particularly true of the important area of psychosocial development. Such few instruments as exist in this area are of dubious validity and reliability. Since it was decided in planning the study that standard measuring techniques and devices would be used as much as possible, this became a limiting factor on the variables that could be measured. With this and certain other limiting factors in mind the following variables were selected for measurement and for comparing the experimental and comparison groups: speechreading, speech intelligibility, the reading of fingerspelling, written language, and educational achievement, including reading. The instruments used for measuring these variables and the manner in which the instruments were used will be described in the chapter on procedures. Since it was hypothesized that the use of fingerspelling would have a generally beneficial effect on development, the following specific hypotheses were formulated.

1. The experimental groups would have significantly higher mean scores than the comparison groups in speechreading ability.
2. The experimental groups would have significantly higher mean scores than the comparison groups on speech intelligibility.
3. The experimental groups would have significantly higher mean scores than the comparison groups on the ability to read fingerspelling.
4. The experimental groups would have significantly higher mean scores than the comparison groups on various measures of written language ability.
5. The experimental groups would have significantly higher mean scores than the comparison groups on educational achievement including reading ability.

This set of hypotheses applied to both the survey study and the experimental study with the exception of the hypothesis concerning speech intelligibility. The very young age of the children in the experimental study made the assessment of speech intelligibility impossible, and this variable was eliminated from the experimental study.

THE SURVEY STUDY

THE SAMPLE

Selection and Description of Schools

At the time the study began in 1963, there were three residential schools for deaf children in the United States which systematically used the *Rochester Method* of speech and fingerspelling in instructing deaf children in the classroom, and these were the experimental schools of the present study. The schools were the Rochester School for the Deaf in Rochester, New York; the California School for the Deaf in Riverside, California; and the New Mexico School for the Deaf, in Santa Fe, New Mexico. While all three experimental schools used the *Rochester Method* in the classroom with the subjects selected for the study, communication among the children and between the children and school personnel outside of the classroom was conducted in the usual combination of the language of signs and fingerspelling which is typical of most public residential schools.

In designing the study, two comparison residential schools were selected for each of the experimental schools. The major criteria used in selecting the comparison schools were: (a) location in the same geographical region of the country as the matched experimental school, and (b) similarity in size and composition of student body to the matched experimental school. On the basis of these criteria, the Oregon School for the Deaf and the Washington School for the Deaf were selected as comparison schools for the California School for the Deaf. The Colorado School for the Deaf and the Arizona School for the Deaf were selected for comparison with the New Mexico School for the Deaf. The subjects in the Rochester School for the Deaf were compared with subjects from the New York School for the Deaf at White Plains, New York, and the New Jersey School for the Deaf. Attempts were made to obtain comparison subjects from purely oral residential schools, but the efforts were unsuccessful.

There were two reasons for selecting two comparison schools for each experimental one. First, it is often very difficult to match groups of deaf children among various schools because of the small population involved. By using two schools, it was hoped that good matching could be performed between the experimental school and at least one of the comparison schools. As will be shown later, this turned out to be the case. Second, it was hoped that the use of two comparison schools would aid in isolating the effects of the independent variable of the present study—the *Rochester Method.* If subjects within each experimental school were consistently better than subjects within the two comparison schools, it was felt that this would give a rather clear indication that the effects were due to the difference in method rather than to other possible differences among the schools.

The results during the first three years of testing showed that within each of the three groups of schools no differences emerged between the two comparison schools and that differences did emerge usually between the experimental school and both comparison schools within each group. In order to reduce the amount of testing involved, one of the comparison schools from each of the three groups was eliminated for the final two years of testing in the survey study. The comparison school retained within each of the three groups was the one in which the subjects most closely matched the subjects in the experimental school. In order to simplify presentation of the statistical data, only the experimental school and the comparison school retained with it throughout the five years of the study are presented in the results of the survey study. However, the data on the first three years of testing in the comparison schools which were eliminated during the last two years are presented in an appendix of this report.

Selection of Subjects

Certain restrictions were purposefully placed on the population to be investigated for two reasons: (1) to limit the population to prelingually and profoundly deaf children; and (2) to eliminate the need for matching on as many variables as possible. Only students who met certain criteria were considered for inclusion in the study. These criteria were: (1) sensori-neural hearing loss of at least 75 decibels (ASA standard) in the better ear averaged across the frequencies of 500, 1,000 and 2,000 cycles per second; (2) IQ of at least 80 on the performance scale of the WISC or the WAIS; (3) age at onset of deafness of three years or younger; and (4) no apparent handicap other than deafness. In addition, an attempt was made to eliminate any potential subjects who were expected to leave the school within two years after the start of the study. In addition to these restrictions, certain age limitations also were inherent in the design of the project. In the California School and the Rochester School, only those students were considered as possible subjects who had just entered the intermediate departments of the schools in the year 1963 when the study began. This insured that all subjects in those two schools had just begun instruction by the *Rochester Method* in the year the study began. Because of this requirement, children were at least 12 years old in those two schools in the initial year of the project. In the New Mexico School where fingerspelling is begun from the time the child enters school, a lower age limit of nine years was placed on the subjects because several of the tests used in the study could not be administered reliably to children of a younger age.

All students in the three experimental and six comparison schools who met the requirements were considered potential subjects for the investigation. Descriptive data on the students were obtained from the school files for the variables of chronological age, number of years of previous schooling, degree and type of hearing loss, and age at onset of hearing loss. It was necessary in most cases, however, to administer the performance scale of either the WISC or the WAIS to obtain an IQ for the subjects. When the target population had been limited in the schools as described, students from the three experimental schools were then matched with students in the appropriate comparison schools within each of the three groups of schools. Students selected for the study in the California School for the Deaf were matched with students in the Oregon and Washington Schools for the Deaf, students selected in the Rochester School for the Deaf were matched with students in the New York and New Jersey Schools for the Deaf, and students selected in the New Mexico School for the Deaf were matched with students in the Colorado and Arizona Schools for the Deaf. The subjects were matched on an individual basis on IQ, chronological age, and number of years in school where possible. Where individual matching could not be accomplished, group matching between experimental and comparison schools was performed. The restrictive criteria on degree of hearing loss and age at onset of hearing loss eliminated the need for matching on those variables.

PROCEDURES

In this chapter, instruments and techniques for measuring the experimental variables, procedures in collecting and scoring data, and techniques of statistical analysis are described.

Testing was conducted in each of the schools in the survey project each year from 1963 through 1967 inclusively. Testing generally was performed within a two-month period (between the middle of October and the middle of December) in each year so as to minimize any effect of difference in time of administration of tests each year. This procedure was adhered to throughout the five years of testing with only one or two deviations. Testing was conducted (in each school) within a quiet room which could comfortably seat fifteen students, was quiet enough for the administration of speech tests, and could be darkened for the administration of filmed tests of speechreading and fingerspelling.

Measurement of the Experimental Variables

The main interest in the investigation was on the effects which might be produced in language and communication development by the combined use of speech and fingerspelling in the *Rochester Method.* This emphasis on language and communication was of major importance in selecting the areas in which testing could be performed and the tests which would be used. The tests administered each year consisted of speech intelligibility, speechreading, receptive fingerspelling, educational achievement, and written language. In the final year of testing in the survey study (1967) a technique using "Cloze" procedures was applied.

Communication Ability

Communication ability for the purposes of this study included speech intelligibility, speechreading, and the ability to read fingerspelling. Speech intelligibility was assessed from taped samples of the speech of the subjects. Each subject read the phonetically balanced familiar (PBF) words for recording. These fifty word units were selected from the original Harvard PB Lists and standardized for use with deaf children by Hudgins (1949). Four different lists of words were used and the words on each list were scrambled by random selection to provide ten versions of each list, thus giving a total of 20 lists of 50 words each. These lists were mimeographed for presentation to the subjects.

Speechreading ability was assessed by means of Form A of the Utley Test of Lipreading (Utley, 1946) and the Craig Lipreading Inventory (1964). The Utley Test was used during the first three years of the study. The Craig Lipreading Inventory was begun in the second year of the study and used throughout the remaining four years of the project. The Utley was used initially because data were available on it from several previous projects (Quigley and Frisina, 1961). However, previous studies and an analysis by DiCarlo and Kataja (1951) have shown that the Utley Test is a very difficult test for deaf children even though it was standardized on deaf students. Experience in the first year of testing of

the present project confirmed this, and so the Craig Lipreading Inventory was begun in the second year of the study. At the end of the third year of the project, when three of the comparison schools were eliminated to reduce testing load, the Utley Test of Lipreading was eliminated from the project for the same reason.

Both the word and sentence versions of Form A of the Craig Lipreading Inventory were used during the last four years of the project. This lipreading inventory, which was constructed by Craig (1964), was prepared in a filmed edition for the present project by the Oregon College of Education under a sub-contract with the University of Illinois. The word version of the test consists of the presentation of 33 simple words by a female speaker with each word being preceded by the carrier phrase, "Show me the ...." Each child has an answer sheet prepared in multiple choice form. For each word presented by the female speaker, the child has four choices from which to select. Each choice is presented both pictorially and verbally. The child simply has to draw a large "X" on the picture and word which he thinks represents the word said by the speaker. The sentence version of the test is similar to the word version except that sentences are presented by the speaker and the child has four sentences in pictorial and verbal form to which to respond for each stimulus item.

Ability to read fingerspelling was assessed by means of a test prepared by Quigley and Frisina (1961) for their study of the effects of institutionalization on the psychoeducational development of deaf children. In constructing this test, a deaf instructor at Gallaudet College noted for the clarity of his fingerspelling was instructed to spell 31 sentences of Form B of the Utley Test of Lipreading at a comfortable rate of speed. A film was made of this production and this is the film which was used in the present project for assessing ability to read fingerspelling.

Language Ability

Language ability was assessed by tests of reading, written language, and "Cloze" procedures. Reading was assessed by means of the Paragraph Meaning and Word Meaning sub-tests of the Stanford Achievement Test. Written language samples were obtained from the subjects each year by presenting them with a set of six cartoon sequences and asking them to write a story about each sequence. Each cartoon sequence consisted of four drawings telling a simple story. During the last year of the study, "Cloze" procedures were used to gain another index of the language ability of the subjects. This procedure was described in an earlier section of the report where data on Moores (1967) study were presented.

Educational Achievement

Educational achievement was assessed by administration of the Stanford Achievement Test in each year of the study. Only five sub-tests were used regardless of which battery was involved: Paragraph Meaning, Word Meaning, Language, Arithmetic Reasoning, and Arithmetic Computation. An average reading score was computed for the Paragraph Meaning and Word Meaning sub-tests and an average arithmetic score for the Arithmetic Reasoning and Arithmetic Computation sub-tests. In addition, the Battery Median was also computed. In the first year of the study, each student was administered the primary, elementary, intermediate, or advanced battery of the Stanford Achievement Test which cor-

responded to his level on the most recent achievement testing of his school. In each succeeding year, the sub-tests for each student were examined and he was advanced to the next battery of the test when he approached the ceiling on any of the sub-tests. It should be noted that the same form of the Stanford Achievement Test (Form N) was used in each of the five years of the study.

Collection of the Data

The data for the study were collected from available school records and from testing conducted by the investigator or other personnel involved in the project.

School Records

All of the participating schools made their records freely available for the study. From these records, data on sex, chronological age, length of time in school, method of instruction used in the classroom, type of hearing loss, degree of hearing loss, age at onset of hearing loss, residential status, hearing ability of parents and siblings, racial origin, the use of hearing aids, previous schools attended, including preschool, and the periods of attendance, and other pertinent data were obtained. Some of these data were acquired for purposes of restriction of the population and matching of the samples and some were obtained for use in various subanalyses made of the data. For some of the subjects the IQ on the performance scale of the WISC or WAIS was available and was used for the purposes of the study. Where such IQs were not available in school records on these tests, the tests were administered by qualified personnel within each school.

Testing Program

All testing was conducted by use of speech, fingerspelling, the language of signs, and writing. This was considered necessary to be as sure as possible that the test instructions were understood by the children. While the standard instructions on most of the tests were followed as closely as possible, the basic criterion in testing was to be sure that the student understood exactly what was expected of him before testing began. Testing was conducted each year in both group and individual sessions generally lasting for a period of three days.

Group Testing. On the first day of testing each year, a battery of tests was administered in group sessions, consisting of the filmed tests of lipreading (The Utley and the Craig tests) and fingerspelling, the written language test, and in the last year of the study the "Cloze" procedures. Testing was conducted with groups of from eight to twelve children depending on the age of the subjects, with younger subjects being tested in the smaller groups. These group sessions usually lasted between one and a half and two hours with the children being given rest periods at appropriate intervals. The tests were administered in the following order: fingerspelling; Craig Lipreading Inventory, Word Version; Craig Lipreading Inventory, Sentence Version; the Utley Test of Lipreading; written language; and "Cloze" procedures.

The fingerspelling and speechreading films were shown on standard motion picture equipment made available by each school. The subjects were supplied with prepared forms on which to write their responses to the filmed stimuli. In each of the filmed tests of fingerspelling and lipreading, standard instructions were adhered to and examples were shown to the children prior to presentation of the experimental items. Care was taken during the presentation of the sample items that each subject fully understood what to do. The test items then were presented and ample time was allowed at the end of each stimulus for the subject to make his response.

Both the fingerspelling test and the Utley Test of Lipreading contained 31 sentences with a total of 124 words in the speechreading test and 126 words in the fingerspelling test. The tests are scored on the basis of the number of words correct. This was done in the present study and the number of words correct for each subject was converted to the percent correct of the total number of words. The word version of the Craig Lipreading Inventory contains 33 words. The number of correct words was scored and converted to a percent correct of the total number of words. The sentence version of the Craig Lipreading Inventory was scored in similar fashion with the number of correct sentences being converted to the percent correct of the total number of 24 sentences.

Written language samples were elicited by presenting the subject with six sets of cartoon sequences with each sequence depicting a simple story. The children were requested to write stories about the cartoon sequence. They were told they could write anything they wanted but that they should try to write as much as possible. No time limitation was placed on this procedure and the children were urged at intervals to write as much as they possibly could about each cartoon sequence.

In scoring the written language productions, the first problem faced was in determining what was a sentence within the body of any given language sample. To resolve this, a set of rules was constructed for determining sentences within the corpus. Each of the written samples then was divided into sentences by two scorers independently, and any differences between the two scorers in the division of a particular corpus were resolved by a third person. The resulting language samples then were punched on IBM cards and print-out sheets were obtained of the language samples from the IBM 7094 Computer at the University of Illinois. The computer also was used to perform certain quantitative analyses of the data, which will be explained in presentation of these data in the section on results. The measures made on the written samples were total number of words in the sample, total number of sentences, mean number of words per sentence, the type token ratio, the grammatical correctness ratio, the strings analysis, and the subordination ratio. Each of these analyses will be discussed in the appropriate section of the chapter on results. All of the written language measures, and in fact all measures in the project, were scored independently by two persons, and any differences between the two persons were resolved by a third individual.

The "Cloze" procedure for examining the language functioning of the subjects was used only in the last year of the project. The use of this procedure was a direct outgrowth of the doctoral dissertation by Moores (1967) which was discussed in a preceding chapter of this report. In the present study, each subject was presented with a 250-word passage from a graded reading text. Each fifth word in the text was eliminated in the version presented to the subject and the subject was asked to write the most appropriate word in each blank space. For the subjects in the present study, their reading grade levels were determined by examining their reading scores for the previous year of testing. Each subject then was presented with a 250-word passage selected from a text graded at his reading level. The subjects were told first to read the material through carefully and then were told to read it again but this time they were to fill in the blank spaces with what they considered to be the most appropriate words. The measures obtained on this procedure were a Verbatim Score, a Form Class Score, and a Verbatim Given Form Class Score. Again each measure was determined independently by two scorers and any differences between the two were resolved by a third individual. Each of these measures will be discussed in more detail in the appropriate section of the chapter on results.

Educational Achievement. Educational achievement was determined for each subject by administration of the Stanford Achievement Test. Form N was used in each of the five years of the study and only the subtests of Paragraph Meaning, Word Meaning, Language, Arithmetic Computation, and Arithmetic Reasoning were used regardless of the battery level administered to a particular student. In addition to the five subtests, a Combined Reading Score, a Combined Arithmetic Score, and a Battery Median Score were obtained by the standard procedures used in this test.

Individual Testing. The speech testing was recorded on a portable Ampex 1260 tape recorder with an Electro-Voice Model 664 microphone. This equipment was transported to each school by the investigators so that comparable recording apparatus was used for all subjects. The recordings were made in a suitably quiet room provided by each of the participating schools. The procedures for testing outlined by Hudgins (1949) were adhered to as closely as possible.

Each student was tested individually. Prior to recording, the student was given a copy of the list of words he was to read and was allowed to read these silently for as long as he wished in order to familiarize himself with the words. Then he read the list to the investigator who corrected obvious mispronunciations. This procedure was repeated until the student knew the correct pronunciation of each word. When coaching had been completed, the student was given a sample list of words to read aloud and the tape recorder was adjusted to provide a suitable recording level. The subject then was given the test list of words and instructed to read them aloud. He was told to pause and raise his hand before attempting any word of which he still was unsure. When this occurred, the tape recorder was stopped and the subject was coached until he could pronounce the word correctly. The procedure was repeated until all fifty words had been recorded. These procedures were necessary to insure that the test was one of speech intelligibility and not of vocabulary level.

The intelligibility of the speech recordings was judged by a group of trained listeners. According to Hudgins, the selection of listeners is of importance. If persons with considerable training and experience in teaching speech to deaf children are used, the intelligibility scores are likely to be unrealistically high. If persons completely unfamiliar with the speech of deaf children are used, the opposite effect is likely. In this study, a procedure similar to that proposed by Hudgins was used during the first three years and a slightly different procedure was used during the remaining two years of the study.

Four sophomore students in the teacher training class in the education of the deaf at the University of Illinois served as listeners during the first three years of testing. These persons had normal hearing and discrimination as determined by a speech intelligibility test which was administered prior to their selection. After their selection, they were required to listen to the recorded speech of a number of deaf children who were not subjects in the present study. Several training sessions of approximately two hours each were conducted until the listeners reached a plateau in their learning curves. The listeners also were required to memorize the entire list of 200 words to the point where they could reproduce it from memory on three consecutive days. This was done to eliminate vocabulary as a variable.

When training and memorization sessions were completed, the listeners audited the tape recordings for the study. The auditing sessions were conducted for approximately two hours per day, three to five days a week. The total assessment procedure for each year of speech samples required about twelve weeks. All sessions were conducted in a quiet room; the recordings were played back on an Ampex 1260 tape recorder with matching amplifier speaker. After each word had been presented, listeners were allowed time to write on a prepared form what they perceived. Each deaf student's score was the average of the number of words correctly identified by the four listeners. The average number of words correctly identified was converted to percent correct of the fifty words.

The group of four sophomore students from the teacher training program served as auditors during the first three years of the project. Upon their graduation from the University of Illinois, another panel of four persons was selected; however, these were persons who had never had any exposure to the speech of deaf children. The first two weeks of their training sessions were conducted on the last set of tape recordings which had been scored by the initial panel. After having been trained to a learning plateau on these speech samples, their scores were compared with the scores of the initial panel and it was found that there were no significant differences between the scores of the two groups. This second group of listeners then served to audit the speech samples in the remaining two years of the study.

The use of listener identification of tape recorded words is a very rigid measure of speech proficiency. Low scores usually are made on such tests by deaf children. However, it will be remembered that the purpose of the present study was to compare two groups of deaf students and not to establish norms for speech intelligibility. Also, the PBF words and the procedures established by Hudgins had been used in previous studies, including the study by Quigley and Frisina (1961), so that data on the test were available in the literature.

Methods of Statistical Analysis

Comparisons were made throughout the survey study between the experimental and comparison groups by means of the random sample 't' test. While the matched samples 't' test would have been a more powerful test of statistical significance, it will be recalled that individual matching of subjects was not always possible and group matching had to be used in a few cases. This dictated the use of the more conservative random samples 't' test. Although significance levels of 10 percent are reported in some instances, the standard 5 percent level is used as the significance

TABLE 1.

DESCRIPTIVE VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 1

	Experimental Schools (N=112)		Comparison Schools (N=110)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	13.18	1.86	13.25	1.99	0.24	--
IQ	106.75	13.22	105.91	11.41	0.51	--
Time in School (years)	8.41	2.35	8.41	2.71	0.01	--
Hearing Loss in Better Ear (decibels, ASA)	88.74	7.48	89.95	7.76	0.11	--
Age at Onset of Hearing Loss (months)	3.21	7.18	3.95	7.56	0.71	--

level in the studies. Even though the direction of expected differences for the hypotheses were stated prior to conducting the studies, the significance levels quoted are for two-tailed tests.

Reliability coefficients were obtained for the variables by correlating the scores on the various measures between the years 1964 and 1965. Those years were selected because all measures were used in those years and very little attrition had taken place in the subject population. Intercorrelation of all measures was performed for the year 1964 to study the relationships among the variables and factor analyses were made to determine the number and type of factors actually being tapped by the individual measures.

RESULTS

This chapter presents the basic analysis made on the data collected in the survey study. First are presented data showing the year by year comparisons between the subjects in the three experimental schools combined and the subjects in the three comparison schools combined. Next are presented the annual comparisons between the experimental and comparison schools in each of the three groups of schools. Certain analyses then are presented concerning the nature of the assessment materials used in the study. These analyses include reliability data on appropriate measures and factor analyses showing the major factors actually measured by the battery of tests used in the study.

Analysis of the Combined Data

Table 1 presents the data on the descriptive variables for the subjects in the combined experimental schools and the subjects in the combined comparison schools. During the first year of testing, there were 112 subjects in the three experimental schools and 110 subjects in the three comparison schools. It can be seen from Table 1 that the two groups of students were matched on the variables of chronological age, IQ, years of previous schooling, degree of hearing loss, and age at onset of hearing loss. There not only were no significant differences between the two groups on these variables but the means and standard deviations for the two groups were almost identical on every variable. The data show that the subjects in the experimental and comparison schools were profoundly and prelingually deaf children, most of whom had been born deaf. Both groups of children had mean IQ scores of approximately 106, had been in school for approximately eight and a half years prior to the initiation of the study, and were on the average about 13 years old.

It will be recalled that the subjects in two of the three experimental schools began fingerspelling just at the time the study was initiated. In the other experimental school fingerspelling had been in use throughout the school for three years prior to initiation of the study. Thus, in the first year of experimental testing most of the subjects had just begun the use of combined speech and fingerspelling. Differences between the two groups were not expected on the experimental variables in this year, and it can be seen from Table 2 that this was the case.

Table 2 shows the data on the experimental variables for the experimental and comparison schools in the first year of testing. This testing was performed during October, November, and December in 1963. The only statistically significant difference between the two groups of schools

TABLE 2.

EXPERIMENTAL VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 1

	Experimental Schools (N=112)		Comparison Schools (N=110)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	61.75	23.55	44.28	30.49	5.36	.001
Speechreading						
Utley Test	11.26	9.56	9.97	10.46	1.04	--
Speech Intelligibility	16.40	15.40	19.46	16.77	1.41	--
Stanford Achievement						
Paragraph Meaning	3.66	1.10	3.49	1.18	1.32	--
Word Meaning	3.30	0.94	3.30	1.02	0.03	--
Combined Reading	3.50	0.97	3.44	1.06	0.58	--
Language	3.97	2.19	4.06	2.38	0.32	--
Arithmetic Reasoning	4.01	1.59	3.39	1.60	0.79	--
Arithmetic Computation	4.82	1.52	4.79	1.69	0.25	--
Combined Arithmetic	4.43	1.50	4.36	1.62	0.44	--
Battery Median	3.87	1.35	3.73	1.35	1.01	--
Written Language						
Type Token Ratio	51.29	8.83	50.36	11.60	0.66	--
Grammatical Correctness Ratio	81.34	11.98	79.65	11.72	1.05	--
Subordination Ratio	5.53	8.25	7.50	14.11	1.24	--
Sentence Length	7.32	2.97	7.43	4.75	0.21	--
Strings Analysis	4.71	1.88	4.51	1.96	0.76	--

TABLE 3.

EXPERIMENTAL VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 2

	Experimental Schools (N=113)		Comparison Schools (N=110)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	66.77	26.02	52.97	28.25	3.97	.001
Speechreading						
Utley Test	13.23	11.13	12.74	10.91	0.36	--
Craig Word Test	61.87	19.63	66.98	13.99	1.71	.01
Craig Sentence Test	57.67	22.68	61.04	19.22	1.10	--
Speech Intelligibility	21.84	17.82	22.30	18.86	0.19	--
Stanford Achievement						
Paragraph Meaning	3.93	1.42	3.77	1.18	0.88	--
Word Meaning	3.62	1.15	3.52	1.18	0.62	--
Combined Reading	3.79	1.24	3.67	1.14	0.76	--
Language	4.64	2.68	4.68	2.79	0.13	--
Arithmetic Reasoning	4.47	1.89	4.37	1.78	0.46	--
Arithmetic Computation	5.07	1.82	5.18	1.77	0.57	--
Combined Arithmetic	4.79	1.82	4.81	1.73	0.09	--
Battery Median	4.30	1.70	4.17	1.57	0.67	--
Written Language						
Type Token Ratio	54.33	8.75	52.38	8.64	1.64	.10
Grammatical Correctness Ratio	82.90	8.96	79.75	12.73	2.08	.05
Subordination Ratio	8.07	11.07	7.46	10.61	0.38	--
Sentence Length	8.01	2.79	8.12	3.16	0.27	--
Strings Analysis	4.74	2.08	4.46	2.41	0.90	--

was on the fingerspelling variable where the subjects in the experimental schools had a mean score of 61.75 percent as compared to the mean score of 44.28 percent for the subjects in the comparison schools. The difference probably resulted from the fact that the children in one of the three experimental schools had been subjected to fingerspelling in the classroom for three years prior to initiation of the project. Also, while the children in the other two experimental schools had not been involved in the systematic use of fingerspelling in the classroom prior to initiation of the study, the use of fingerspelling in the classroom with older children in those schools tended to promote greater use of fingerspelling by most children in the schools in the out-of-class hours.

There were five groups of tests involved in the experimental variables in the first four years of testing. These were (1) the Stanford Achievement Test, (2) a fingerspelling test, (3) tests of lipreading ability, (4) a test of speech intelligibility, and (5) several measures of written language productions. In the Stanford Achievement Test only the subtests of Paragraph Meaning, Word Meaning, Language, Arithmetic Reasoning, and Arithmetic Computation were used, regardless of the battery of the test. From the subtest scores, a Combined Reading Score, a Combined Arithmetic Score, and the Battery Median were computed.

The several measures of written language used were the Type Token Ratio, the Grammatical Correctness Ratio, the Subordination Ratio, the Mean Sentence Length, and the Strings Analysis. All measures were made on the first 100 words produced by the subjects in their written samples. The Type Token Ratio as used in the present study was the percentage of different words in the first 100 words of written language produced by the subjects. The Grammatical Correctness Ratio was computed in the manner recommended by Birch and Stuckless (1966). The scores represented the percentage of words in the first 100 which were grammatically correct. The Subordination Ratio was a measure of language complexity and was the ratio of the number of dependent to independent clauses in the first 100-word sample of written language produced by the subjects. The Mean Sentence Length was simply the average number of words used per sentence. The Strings Analysis represented the mean number of words per sentence which were used in appropriate word order.

Table 3 shows the data on the experimental variables for the second year of the study. Again, the major difference between the two groups was on the fingerspelling scores where the subjects in the experimental schools were significantly superior to those in the comparison schools. The only other differences which reached statistical significance were on the word version of the Craig Lipreading Inventory where the subjects in the comparison schools had a significantly higher mean score than those in the experimental schools and the Grammatical Correctness Ratio where the experimental group was superior to the comparison group. Thus, the first year of fingerspelling in the experimental schools produced few significant increases on any of the variables over the scores obtained by the comparison schools.

Table 4 shows the data on the experimental variables for the third year of testing or the end of the second year in which the study was in progress. It can be seen that many significant differences emerged between the two groups of schools and that most of those differences were in favor of the subjects in the experimental schools. The data indicated

TABLE 4.

EXPERIMENTAL VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 3

	Experimental Schools (N=105)		Comparison Schools (N=109)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	77.53	19.85	59.71	28.01	4.91	.001
Speechreading						
Utley Test	14.83	10.77	13.99	10.79	0.62	--
Craig Word Test	64.78	19.42	67.79	15.87	0.91	--
Craig Sentence Test	60.33	21.82	63.80	19.93	0.99	--
Speech Intelligibility	22.80	18.59	25.36	18.64	1.22	--
Stanford Achievement						
Paragraph Meaning	4.56	1.68	3.99	1.41	2.68	.01
Word Meaning	4.20	1.46	3.71	1.16	2.68	.01
Combined Reading	4.41	1.52	3.87	1.24	2.78	.01
Language	5.56	2.80	5.04	2.77	1.50	--
Arithmetic Reasoning	5.18	2.08	4.62	2.08	2.35	.02
Arithmetic Computation	5.91	1.98	5.38	1.85	2.18	.05
Combined Arithmetic	5.58	1.98	5.03	1.90	2.32	.02
Battery Median	5.04	1.87	4.42	1.67	2.82	.01
Written Language						
Type Token Ratio	54.59	6.61	51.95	7.07	2.80	.01
Grammatical Correctness Ratio	83.78	8.74	80.86	10.07	2.23	.05
Subordination Ratio	14.53	19.75	7.56	9.84	3.25	.01
Sentence Length	9.25	4.13	8.19	3.57	1.97	.05
Strings Analysis	5.06	2.33	4.29	1.85	2.68	.01

that the significant difference between the two groups on fingerspelling ability was accompanied by significant differences in favor of the experimental schools on most of those variables in which meaningful language was involved. While the superiority in fingerspelling ability on the part of the subjects in the experimental schools was accompanied by significant differences in these variables, it was not accompanied by such differences in the oral measures of lipreading proficiency and speech intelligibility. It should be noted, however, that no significant deficiency on the part of the experimental schools was evident in this respect in comparison to the subjects in the comparison schools.

Table 5 shows the data on the experimental variables in the fourth testing session at the end of the third year of the study. The results were similar to those for the previous year's testing. The significant differences which appeared between the two groups on most of the variables were in favor of the subjects in the experimental schools. Again, significant differences did not appear on the measures of speechreading ability and speech intelligibility. It will be noted that attrition of subjects had begun to reduce the number in both groups.

Table 6 shows the experimental data during the fifth testing session at the end of the fourth year of the study. The decreasing number of subjects due to graduation had lowered the statistical significance of some of the differences between the groups; however, there still were significant differences on most of the variables in favor of the experimental group.

In this final year of testing, the "Cloze" procedures were added to the test battery. In the "Cloze" procedure, as described previously, the subject had to replace words which had been deleted from a written corpus. The Verbatim Score represented the percentage of items in which the subject was able to replace the exact word which had been deleted. The Form Class Score represented, in percentage, the extent to which the subject was able to replace a deleted word with a word from the same form class or grammatical category (*e.g.*, an adjective for an adjective). The classification system developed by Fries (1952) and modified by Moores (1967) was used for determining correct form class responses. The form class factor provided a measure of the individual's internalized grammatical structure. The Verbatim Given Form Class score reflected the ability of the subjects to make correct verbatim responses given a common grammatical base and was computed by dividing the number of correct verbatim words by the number of correct form class responses. For example, an individual with 20 verbatim and 40 correct form class responses would have a Verbatim Given Form Class Score of 20 ÷ 40 or 50 percent.

It can be seen from Table 6 that a statistically significant difference existed on Form Class Score in favor of the experimental group. This indicated better knowledge of the basic grammatical structure of English for this group than for the comparison group.

Analysis of the Paired Schools

The design of the study involved three sets of paired schools with one member of each pair being an experimental school in which the subjects were systematically exposed to the use of fingerspelling and speech in the classroom, and the other a comparison school in which oral and some combinations of manual methods were used. The preceding section

TABLE 5.

EXPERIMENTAL VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 4

	Experimental Schools (N=92)		Comparison Schools (N=91)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	79.80	18.32	67.92	24.40	3.82	.001
Speechreading						
Craig Word Test	67.54	17.78	71.96	13.13	1.59	--
Craig Sentence Test	64.58	23.04	62.98	21.25	0.49	--
Speech Intelligibility	21.62	16.99	23.38	18.72	0.63	--
Stanford Achievement						
Paragraph Meaning	4.79	1.78	4.06	1.38	3.33	.001
Word Meaning	4.35	1.59	3.93	1.23	2.18	.05
Combined Reading	4.58	1.64	4.02	1.25	2.83	.01
Language	6.11	2.84	5.48	2.61	1.66	.10
Arithmetic Reasoning	5.58	1.82	4.77	2.10	3.55	.001
Arithmetic Computation	6.27	1.79	5.69	1.94	2.73	.01
Combined Arithmetic	5.96	1.76	5.25	1.98	3.29	.001
Battery Median	5.41	1.73	4.72	1.68	3.27	.01
Written Language						
Type Token Ratio	55.89	8.29	54.57	8.15	1.08	--
Grammatical Correctness Ratio	86.63	7.79	82.74	9.81	2.96	.01
Subordination Ratio	14.53	12.76	15.33	11.66	0.33	--
Sentence Length	8.93	3.56	8.47	3.45	0.87	--
Strings Analysis	5.52	2.49	4.85	2.40	1.85	.10

TABLE 6.

EXPERIMENTAL VARIABLES
COMBINED EXPERIMENTAL AND COMPARISON SCHOOLS - YEAR 5

	Experimental Schools (N=84)		Comparison Schools (N=79)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	84.16	16.04	71.36	20.72	4.41	.001
Speechreading						
Craig Word Test	70.72	16.06	74.34	10.15	1.70	.10
Craig Sentence Test	67.93	20.09	69.30	18.63	0.45	--
Speech Intelligibility	25.48	19.56	22.21	18.31	1.05	--
Stanford Achievement						
Paragraph Meaning	5.13	1.99	4.40	1.53	2.61	.01
Word Meaning	4.75	1.81	4.21	1.45	2.06	.05
Combined Reading	4.91	1.84	4.28	1.42	2.42	.02
Language	6.59	3.18	5.59	2.64	2.09	.05
Arithmetic Reasoning	6.16	2.10	5.23	2.17	2.76	.01
Arithmetic Computation	6.78	2.26	6.09	1.90	2.06	.05
Combined Arithmetic	6.44	2.12	5.64	1.99	2.48	.02
Battery Median	5.88	2.06	5.04	1.78	2.77	.01
Written Language						
Type Token Ratio	56.58	7.13	55.01	6.15	1.49	--
Grammatical Correctness Ratio	85.83	8.38	82.75	8.96	2.26	.05
Subordination Ratio	14.40	17.32	10.95	15.20	1.34	--
Sentence Length	9.74	4.26	9.03	3.98	1.10	--
Strings Analysis	5.98	2.74	5.21	2.57	1.86	.10
"Cloze" Procedures						
Verbatim	25.92	12.95	23.83	12.79	1.00	--
Form Class	66.83	14.99	60.96	14.66	2.41	.02
Verbatim/Form Class	37.14	15.09	37.54	15.51	0.16	--

TABLE 7.

DESCRIPTIVE VARIABLES - GROUP 1 SCHOOLS - YEAR 1

	Experimental School (N=40)		Comparison School (N=38)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	13.13	0.87	13.02	1.75	0.29	--
IQ	107.54	13.32	105.46	12.08	0.75	--
Time in School (years)	8.32	1.81	7.76	2.10	1.26	--
Hearing Loss in Better Ear (decibels, ASA)	90.36	6.70	92.34	9.61	1.06	--
Age at Onset of Hearing Loss (months)	3.54	7.84	4.41	7.97	0.50	--

has shown that the subjects for the three experimental schools combined were generally superior to the subjects in the comparison schools during the last three years of the four-year study. This section presents similar analyses for each of the three pairs of schools separately.

Group 1 Schools

Table 7 shows the descriptive variables for the subjects in Group 1 schools. There were 40 experimental subjects and 38 comparison subjects. It can be seen that the subjects in the two schools were matched on the relevant variables of chronological age, IQ, years of previous schooling, degree of hearing loss, and age at onset of hearing loss. The subjects were profoundly, prelingually deaf children of approximately 13 years of age and slightly above average intelligence who had been exposed to oral training within the classroom until the year the study began. In that year, the subjects in the experimental school began study in the Intermediate Department where instruction was by means of fingerspelling and speech. Most of the subjects in the comparison school continued in oral classes, but during the four years in which the study was in progress an increasing number of those students were assigned to classes in which some manual procedures were used.

Table 8 shows the data on the experimental variables for the two schools at the beginning of the first year of the project. The only statistically significant difference between the two groups was on the Subordination Ratio and in favor of the comparison school. All other scores for the two schools were almost identical. It was hoped that such would be the case. Since the students in both schools had been exposed to similar oral methods in the classroom for the approximately eight years they had been in school prior to the initiation of the study, any differences that might have emerged between the groups on any of the experimental variables in the initial testing would likely have been due to differences between the schools other than differences in the classroom communication methods. The problem to be examined was whether the introduction of combined fingerspelling and speech in the classroom to the students in the experimental school during the next four years of the study would result in significantly higher performance for these students when compared to subjects in the comparison school.

Table 9 shows the data on the experimental variables for the two schools at the beginning of the second year of the study. It can be seen that there were only a few significant differences between the two schools. The experimental school had higher scores on the fingerspelling variable than the subjects in the comparison school; however, it will be noted that the absolute difference between the two groups was only 10 percent and did not reach the level of significance. There was a difference in favor of the experimental school on the sentence version of the Craig Lipreading Inventory and this difference reached statistical significance.

Table 10 shows the experimental data for the beginning of the third year of study. Again, it will be noted that there were few significant differences between the two schools; however, there were two differences of some importance. First, the experimental school had a significantly higher Type Token Ratio score than the comparison school. This would indicate greater vocabulary diversity in the written language productions of the subjects in the experimental school. Second, the subjects in the experimental school had significantly higher scores on the Grammatical

TABLE 8.

EXPERIMENTAL VARIABLES - GROUP 1 SCHOOLS - YEAR 1

	Experimental School (N=40)		Comparison School (N=38)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	50.52	24.44	53.08	28.65	0.42	--
Speechreading						
Utley Test	14.40	9.22	11.01	11.78	1.42	--
Speech Intelligibility	16.99	14.43	23.55	21.90	1.57	--
Stanford Achievement						
Paragraph Meaning	3.51	0.80	3.50	1.19	0.03	--
Word Meaning	3.18	0.72	3.14	0.93	0.22	--
Combined Reading	3.38	0.72	3.34	1.03	0.19	--
Language	3.70	1.24	4.31	2.54	0.99	--
Arithmetic Reasoning	3.79	1.39	3.77	1.70	0.06	--
Arithmetic Computation	4.66	0.89	4.76	1.73	0.32	--
Combined Arithmetic	4.26	1.10	4.29	1.68	0.12	--
Battery Median	3.64	0.90	3.66	1.42	0.09	--
Written Language						
Type Token Ratio	50.95	9.89	49.18	8.82	0.83	--
Grammatical Correctness Ratio	83.45	8.54	83.26	9.21	0.09	--
Subordination Ratio	4.76	6.88	10.12	14.99	2.04	.05
Sentence Length	6.96	3.41	7.32	2.51	0.53	--
Strings Analysis	4.68	1.48	4.96	1.96	0.71	--

TABLE 9.

EXPERIMENTAL VARIABLES - GROUP 1 SCHOOLS - YEAR 2

	Experimental School (N=38)		Comparison School (N=36)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	65.60	19.46	55.82	29.03	1.70	.10
Speechreading						
Utley Test	14.31	8.77	11.65	9.64	1.21	--
Craig Word Test	69.45	14.49	64.26	16.48	1.42	--
Craig Sentence Test	65.32	19.27	55.47	20.81	2.08	.05
Speech Intelligibility	24.94	15.95	28.27	23.76	0.70	--
Stanford Achievement						
Paragraph Meaning	3.81	0.96	4.03	1.17	0.90	--
Word Meaning	3.61	0.77	3.48	1.15	0.57	--
Combined Reading	3.73	0.81	3.78	1.14	0.24	--
Language	3.87	2.28	4.05	2.99	0.30	--
Arithmetic Reasoning	4.83	1.38	4.86	1.98	0.08	--
Arithmetic Computation	5.48	1.24	5.36	1.83	0.32	--
Combined Arithmetic	5.16	1.28	5.13	1.86	0.08	--
Battery Median	4.33	1.31	4.39	1.69	0.16	--
Written Language						
Type Token Ratio	53.47	6.41	51.91	7.22	0.98	--
Grammatical Correctness Ratio	83.92	7.24	84.23	8.54	0.16	--
Subordination Ratio	5.47	7.77	10.69	14.44	1.95	.10
Sentence Length	7.55	2.70	8.08	3.06	0.78	--
Strings Analysis	4.56	1.82	4.78	2.14	0.50	--

TABLE 10.

EXPERIMENTAL VARIABLES - GROUP 1 SCHOOLS - YEAR 3

	Experimental School (N=35)		Comparison School (N=36)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	74.81	17.07	69.29	23.84	1.13	--
Speechreading						
Utley Test	16.82	10.19	13.64	9.11	1.41	--
Craig Word Test	71.93	12.96	71.86	15.94	0.02	--
Craig Sentence Test	58.58	16.47	61.51	20.29	0.68	--
Speech Intelligibility	23.86	17.81	26.23	21.39	0.51	--
Stanford Achievement						
Paragraph Meaning	4.37	1.33	4.33	1.49	0.14	--
Word Meaning	4.15	1.09	3.77	1.22	1.39	--
Combined Reading	4.29	1.14	4.07	1.31	0.75	--
Language	4.64	2.30	4.95	2.83	0.51	--
Arithmetic Reasoning	5.00	1.38	5.32	2.34	0.70	--
Arithmetic Computation	5.78	1.28	5.74	1.94	0.09	--
Combined Arithmetic	5.42	1.28	5.55	2.08	0.31	--
Battery Median	4.74	1.35	4.82	1.81	0.20	--
Written Language						
Type Token Ratio	54.79	5.48	51.37	7.86	2.14	.05
Grammatical Correctness Ratio	85.51	7.65	80.63	10.31	2.28	.05
Subordination Ratio	11.37	14.01	6.49	7.83	1.86	.10
Sentence Length	8.36	3.27	8.61	4.63	0.27	--
Strings Analysis	4.65	1.68	4.75	2.16	0.22	--

TABLE 11.

EXPERIMENTAL VARIABLES - GROUP 1 SCHOOLS - YEAR 4

	Experimental School (N=32)		Comparison School (N=36)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	80.56	16.67	78.69	21.73	1.06	--
Speechreading						
Craig Word Test	75.83	11.78	70.02	14.64	1.76	.10
Craig Sentence Test	74.34	18.67	63.10	21.25	2.33	.05
Speech Intelligibility	20.74	16.70	24.30	22.01	0.74	--
Stanford Achievement						
Paragraph Meaning	4.75	1.56	4.39	1.51	0.96	--
Word Meaning	4.59	1.30	4.11	1.34	1.53	--
Combined Reading	4.68	1.40	4.27	1.38	1.24	--
Language	6.06	2.65	5.50	2.70	.87	--
Arithmetic Reasoning	6.03	1.57	5.42	2.22	1.29	--
Arithmetic Computation	6.52	1.59	6.03	2.04	1.11	--
Combined Arithmetic	6.30	1.54	5.74	2.10	1.24	--
Battery Median	5.62	1.50	5.08	1.79	1.34	--
Written Language						
Type Token Ratio	58.00	5.97	53.95	8.32	2.27	.05
Grammatical Correctness Ratio	88.55	7.09	83.84	9.61	2.27	.05
Subordination Ratio	13.41	12.74	15.40	10.55	0.53	--
Sentence Length	8.41	2.72	9.17	3.87	0.92	--
Strings Analysis	5.49	2.10	5.10	2.10	0.76	--

Correctness Ratio than the subjects in the comparison school, indicating a greater degree of grammatical correctness in the written language productions of the subjects in the experimental school.

Table 11 shows the data at the beginning of the fourth year of the project. The subjects in the experimental school again had significantly higher scores than the subjects in the comparison school on the Type Token Ratio and the Grammatical Correctness Ratio. These results indicated greater vocabulary diversity and a higher degree of grammatical correctness in the written language productions of the subjects in the experimental school. It can also be seen that the subjects in the experimental school had higher scores on both the word and sentence versions of the Craig Lipreading Inventory, with the difference reaching statistical significance on the sentence version.

Table 12 shows the data from the testing conducted at the end of the fourth and final year of the project. There were differences in favor of the experimental school on all of the variables except speech intelligibility. While only one of those differences (Form Class Score) exceeded the established .05 level of significance, many of the other differences approached the established level. This consistency of differences in favor of the experimental school, in spite of lack of statistical significance, can be noted in most of the previous tables for the two schools. It should also be noted that while some of the differences did not reach statistical significance, they often were substantial differences in terms of what the achievement levels are on these variables in schools for the deaf throughout the country. It was mentioned in the introductory chapter of this monograph that the differences found throughout the present study must be evaluated in terms of the performance of deaf students in general rather than in terms of norms on some of the tests for the general population. It can be seen, for example, in Table 11 that the grade level for the experimental subjects on the battery median of the Stanford Achievement Test was 5.62 as compared to 5.08 for the subjects in the comparison school. While the difference did not reach statistical significance, it nevertheless was a substantial difference in terms of the advancement made year by year by deaf students on that particular measure. Data available on deaf students in general would indicate that the difference of 0.54 grade level represents the equivalent of about one year or more of teaching. In the final year of testing (Table 12) it can be seen that the Battery Median for the experimental school was 6.25 while that for the comparison school was 5.43, a difference of 0.82 grade level.

In general, it can be said that the two schools were equal, in fact almost identical, on all experimental variables except speechreading at the initiation of the study. During the next four years while fingerspelling was systematically used in the classroom in the experimental school, some differences did emerge in favor of that school, and by the final testing year a number of the differences approached statistical significance. An examination of the data provides some indications as to why greater differences might not have emerged between the two schools. It should be noted that in almost every year of the study, there was no significant difference between the two schools on the fingerspelling variable. Since fingerspelling was systematically used in the classroom in the experimental school with all children, it would have been expected that scores for the children in that school on the ability to read fingerspelling would have been considerably higher than the scores for the children in the

TABLE 12.

EXPERIMENTAL VARIABLES - GROUP 1 SCHOOLS - YEAR 5

	Experimental School (N=32)		Comparison School (N=33)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	84.36	15.90	78.06	16.57	1.56	--
Speechreading						
Craig Word Test	75.84	10.84	73.74	10.29	0.80	--
Craig Sentence Test	73.46	16.05	70.84	18.84	0.60	--
Speech Intelligibility	20.75	17.36	27.19	24.22	1.20	--
Stanford Achievement						
Paragraph Meaning	5.09	1.87	4.76	1.63	0.77	--
Word Meaning	5.05	1.52	4.32	1.47	1.98	.10
Combined Reading	5.05	1.63	4.51	1.48	1.41	--
Language	7.02	3.09	5.83	2.30	1.74	.10
Arithmetic Reasoning	6.73	2.18	5.85	2.25	1.60	--
Arithmetic Computation	7.44	2.26	6.51	1.91	1.79	.10
Combined Arithmetic	7.06	2.18	6.15	2.05	1.73	.10
Battery Median	6.25	2.04	5.43	1.75	1.75	.10
Written Language						
Type Token Ratio	57.44	5.16	55.12	5.32	1.78	.10
Grammatical Correctness Ratio	87.31	8.26	84.18	9.29	1.43	--
Subordination Ratio	13.31	12.39	10.87	13.06	0.77	--
Sentence Length	10.53	4.27	9.79	4.27	0.71	--
Strings Analysis	6.68	3.14	5.50	2.61	1.65	.10
"Cloze" Procedures						
Verbatim	29.03	12.47	22.84	13.24	1.92	.10
Form Class	69.16	13.87	60.18	13.58	2.62	.02
Verbatim/Form Class	40.13	13.31	36.33	15.90	1.03	--

comparison school. There are several possibilities why this did not occur. First, the exposure of the children in the comparison school to manual communication outside of the classroom might have been sufficient for them to acquire equal proficiency in reading fingerspelling as compared to the subjects in the experimental school. Second, the use of fingerspelling in the experimental school might not have been as extensive and as systematic as was supposed to be the case. Third, there could have been greater use of fingerspelling in the classroom in the comparison school than was generally supposed to be the case. Observation by the investigator would indicate that the third possibility was the most likely one. While all comparison subjects were in orally taught classes at the beginning of the study, an increasing number of the subjects became involved in classes using manual communication as the study progressed. This is a common pattern within state residential schools for the deaf, and no attempt was made to counteract it in the survey study. Whereas, in most state residential schools the manual communication used with older children generally relies more heavily on the use of the language of signs than on fingerspelling, that was not the case in the particular comparison school under consideration. The lack of substantial differences between the subjects in the two schools on the fingerspelling variable might have resulted in reducing hypothesized differences between them on the other variables.

Group 2 Schools

Table 13 shows the descriptive data for the subjects in Group 2 Schools. There were 38 subjects at the beginning of the study in the experimental school and 39 in the comparison school who met the criteria for the project. The subjects were profoundly and prelingually deaf students with somewhat above average intelligence who were matched on the relevant variables of chronological age, IQ, years of previous schooling, degree of hearing loss, and age at onset of hearing loss. In fact, it can be seen in Table 13 that the mean scores for the two groups were almost identical on each of the variables. Comparison with the subjects for Group 1 Schools will show that they were very similar to the subjects in the second pair of schools with the exception that the subjects in the second group were approximately one year older at the time the study commenced and had been in school about one and a half years longer.

Table 14 shows the experimental data for the two schools in the first year of testing. This testing was conducted during the fall of 1963. The major significant difference between the two groups was on the variable of fingerspelling where the experimental school had a mean score of 66.42 percent as compared to 43.16 percent for the comparison school. The difference was statistically significant. In the experimental school, the subjects selected were beginning the use of fingerspelling just in the year in which the project began and prior to that time they had been taught in oral classes similar to the subjects in the comparison school. The difference which existed between the groups at the initiation of the study on the fingerspelling measure was likely due to greater use of fingerspelling outside of class hours in the experimental school than is common in most state residential schools. It can be seen from Table 14 that the superiority of the subjects in the experimental school on the fingerspelling variable was accompanied by superiority on the Grammatical Correctness Ratio and the Strings Analysis. This indicated that the

TABLE 13.

DESCRIPTIVE VARIABLES - GROUP 2 SCHOOLS - YEAR 1

	Experimental School (N=38)		Comparison School (N=39)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	14.01	2.17	13.89	2.10	0.15	--
IQ	107.11	12.48	107.03	10.92	0.06	--
Time in School (years)	9.83	2.18	9.65	2.90	0.29	--
Hearing Loss in Better Ear (decibels, ASA)	87.64	6.82	87.47	4.66	0.36	--
Age at Onset of Hearing Loss (months)	3.20	7.31	2.73	7.67	0.25	--

TABLE 14.

EXPERIMENTAL VARIABLES - GROUP 2 SCHOOLS - YEAR 1

	Experimental School (N=38)		Comparison School (N=39)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	66.42	21.64	43.16	29.50	3.94	.001
Speechreading						
Utley Test	13.35	9.14	11.69	9.90	0.76	--
Speech Intelligibility	19.09	19.30	16.52	9.88	0.73	--
Stanford Achievement						
Paragraph Meaning	3.99	1.46	3.72	1.29	0.84	--
Word Meaning	3.60	1.23	3.69	1.22	0.32	--
Combined Reading	3.82	1.29	3.71	1.19	0.38	--
Language	3.97	2.82	4.96	1.94	1.54	--
Arithmetic Reasoning	4.71	1.99	4.42	1.76	0.68	--
Arithmetic Computation	5.63	2.08	5.46	1.73	0.38	--
Combined Arithmetic	5.17	1.99	4.97	1.73	0.48	--
Battery Median	4.38	1.89	4.16	1.44	0.57	--
Written Language						
Type Token Ratio	52.70	8.30	52.74	9.75	0.02	--
Grammatical Correctness Ratio	80.12	14.55	74.26	12.05	1.87	.10
Subordination Ratio	4.07	7.16	10.73	16.71	2.13	.05
Sentence Length	8.07	3.05	8.30	7.42	0.17	--
Strings Analysis	5.35	2.57	4.23	2.13	2.03	.05

subjects in the experimental school had a higher degree of grammatical correctness and a greater use of appropriate word order within their written language productions that did the subjects in the comparison school. There was a significant difference in favor of the comparison school on the Subordination Ratio. Apart from those variables, however, the two groups of subjects did not differ significantly.

Table 15 shows the experimental results for the testing in the second year of the project. At that time, the subjects in the experimental school had completed one year in the combined use of fingerspelling and speech within the classroom. It can be seen that a number of significant differences emerged in favor of the subjects in the experimental school in addition to those which were present in the first year of testing. The experimental subjects had statistically significant scores in their favor on the Speech Intelligibility Test, the Type Token Ratio, the Grammatical Correctness Ratio, and the Strings Analysis. There also was a significant difference in favor of the experimental subjects on the fingerspelling variable.

The results indicated that the subjects in the experimental school performed better than the comparison subjects in their use of vocabulary diversity, grammatical correctness, and appropriate word order within their written productions. It is also interesting to note there was superiority in favor of the experimental subjects on speech intelligibility.

Table 16 shows the results for the two schools in the third year of testing at which time the subjects in the experimental school had completed two full years in the use of fingerspelling and speech in the classroom. It can be seen that there were additional variables on which significant differences appeared in favor of the experimental school. The subjects in that school had significantly higher scores on the Arithmetic Reasoning and Arithmetic Computation sub-tests of the Stanford Achievement Test. In addition, they had significantly higher scores on the Combined Arithmetic Score. The difference between the two groups on the Battery Median for the Stanford Achievement Test was 1.12 grades in favor of the experimental school, and was statistically significant. There were differences in favor of the experimental subjects on the reading sub-tests of the Stanford Achievement Test but they did not quite reach the established .05 level of significance. The subjects in the experimental school also had significantly higher scores on the Type Token Ratio, the Grammatical Correctness Ratio, the Mean Sentence Length, and the Strings Analysis. The results indicated greater vocabulary diversity, greater use of correct grammatical language, greater mean length of sentences, and more appropriate use of word order in the written language productions of the experimental subjects.

Table 17 shows the data for the fourth year of testing at which time the experimental subjects had completed three years under the combined use of fingerspelling and speech in the classroom. It should be noted that the numbers of subjects in both schools had been substantially reduced between the third and fourth testing years. The number in the experimental school decreased from 34 to 25, and the comparison school from 36 to 24. The decreases were due largely to the fact that students are not permitted to remain in those schools beyond the age of 18 years except in special circumstances. This resulted in the loss of a substantial number of subjects from both schools in the project between the third and fourth year of testing. It also resulted in decreases for both schools on the

TABLE 15.

EXPERIMENTAL VARIABLES - GROUP 2 SCHOOLS - YEAR 2

	Experimental School (N=36)		Comparison School (N=37)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	75.78	20.26	55.23	27.09	3.54	.001
Speechreading						
Utley Test	17.98	14.36	16.71	11.13	0.42	--
Craig Word Test	69.70	12.01	70.71	11.02	0.16	--
Craig Sentence Test	65.77	21.64	65.87	16.87	0.02	--
Speech Intelligibility	29.95	21.45	20.62	15.05	2.06	.05
Stanford Achievement						
Paragraph Meaning	4.55	1.86	3.82	1.30	1.69	.10
Word Meaning	4.04	1.44	3.81	1.30	0.71	--
Combined Reading	4.32	1.59	3.84	1.26	1.38	--
Language	5.21	3.31	5.28	2.84	0.09	--
Arithmetic Reasoning	5.26	2.31	4.49	1.69	1.60	--
Arithmetic Computation	6.00	2.19	5.64	1.75	0.78	--
Combined Arithmetic	5.65	2.21	5.09	1.66	1.21	--
Battery Median	5.05	2.22	4.37	1.61	1.48	--
Written Language						
Type Token Ratio	57.31	5.35	52.36	9.91	2.52	.02
Grammatical Correctness Ratio	84.66	8.30	75.49	11.58	3.70	.001
Subordination Ratio	12.84	14.95	7.53	8.59	1.82	.10
Sentence Length	8.88	2.82	8.90	3.49	0.03	--
Strings Analysis	5.30	2.17	3.92	2.39	2.47	.02

TABLE 16.

EXPERIMENTAL VARIABLES - GROUP 2 SCHOOLS - YEAR 3

	Experimental School (N=34)		Comparison School (N=36)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	85.02	14.67	61.42	26.25	4.50	.001
Speechreading						
Utley Test	20.28	10.08	17.95	11.44	0.89	--
Craig Word Test	69.56	18.41	65.22	18.07	0.97	--
Craig Sentence Test	74.85	19.21	74.27	17.30	0.12	--
Speech Intelligibility	30.87	19.54	32.03	14.18	0.20	--
Stanford Achievement						
Paragraph Meaning	5.05	2.06	4.21	1.41	1.98	.10
Word Meaning	4.63	1.74	4.12	1.14	1.45	--
Combined Reading	4.86	1.87	4.19	1.21	1.80	.10
Language	5.92	3.16	5.50	2.95	0.54	--
Arithmetic Reasoning	6.07	2.56	4.80	1.77	2.43	.02
Arithmetic Computation	7.03	2.48	5.79	1.80	2.39	.02
Combined Arithmetic	6.58	2.48	5.34	1.71	2.45	.02
Battery Median	5.83	2.30	4.71	1.59	2.38	.05
Written Language						
Type Token Ratio	56.66	5.86	53.28	6.48	2.19	.05
Grammatical Correctness Ratio	86.24	8.58	78.53	10.76	3.17	.01
Subordination Ratio	22.81	28.19	10.22	9.58	2.43	.02
Sentence Length	11.34	5.47	8.48	2.79	2.64	.02
Strings Analysis	6.14	2.96	3.91	1.70	3.69	.001

TABLE 17.

EXPERIMENTAL VARIABLES - GROUP 2 SCHOOLS - YEAR 4

	Experimental School (N=25)		Comparison School (N=24)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	84.39	12.80	69.99	15.47	3.53	.001
Speechreading						
Craig Word Test	76.49	15.10	78.68	9.67	.59	--
Craig Sentence Test	72.82	17.14	75.47	13.88	.60	--
Speech Intelligibility	28.46	20.44	21.87	13.40	1.31	--
Stanford Achievement						
Paragraph Meaning	4.80	2.01	3.80	0.86	2.24	.05
Word Meaning	4.37	1.92	4.13	1.09	.55	--
Combined Reading	4.60	1.93	3.99	0.93	1.40	--
Language	5.48	2.69	5.45	3.12	.03	--
Arithmetic Reasoning	5.74	2.11	4.65	1.73	1.97	.10
Arithmetic Computation	6.77	1.81	5.97	1.78	1.56	--
Combined Arithmetic	6.28	1.90	5.34	1.72	1.81	.10
Battery Median	5.43	1.95	4.69	1.46	1.50	--
Written Language						
Type Token Ratio	56.96	9.07	57.13	7.55	.07	--
Grammatical Correctness Ratio	86.68	7.79	78.78	9.19	3.22	.01
Subordination Ratio	17.93	17.28	17.18	11.83	.29	--
Sentence Length	10.83	4.89	8.08	3.14	2.30	.025
Strings Analysis	6.20	2.94	4.24	2.19	2.60	.01

scores on many of the experimental variables. The decreases can be noted by comparing the data from Table 16 and Table 17.

In spite of the decreased performance in both schools due to the loss of a number of the higher achieving students in each school, it can be seen from Table 17 that the subjects in the experimental school still were superior to the subjects in the comparison school on a number of the experimental variables. They had significantly higher scores on the Paragraph Meaning sub-test of the Stanford Achievement Test and the difference on the Battery Median between the two schools was still 0.74 grade level in favor of the experimental school. In addition, the experimental subjects had significantly higher scores on the Grammatical Correctness Ratio, Mean Sentence Length, and Strings Analysis, indicating superiority in their written language productions.

Table 18 shows the data for the fifth and final year of testing in Group 2 Schools. The number of experimental subjects was reduced to 21 and the number of comparison subjects to 18. This reduction in numbers was accompanied by a reduction in the differences between the two schools on most of the variables.

In summary, it can be seen from the data on the five years of testing in the Group 2 Schools that the subjects in the experimental school were similar to the subjects in the comparison school in the first year of testing. During the subsequent four years of testing, the experimental subjects achieved increasingly superior scores for two years on most of the experimental variables with a decline in the last two years due to unavoidable loss of subjects. It would appear that some significant factor was present during those years in order to produce the difference between the schools. That factor must not have been present during the first nine or ten years the children were in school since few differences were observable during the first year of testing. The only apparent factor which was introduced during the four years of the project and which could have produced the differences was the use of fingerspelling with the subjects in the experimental school.

Group 3 Schools

Table 19 shows the descriptive variables for the 34 experimental subjects and the 33 comparison subjects in Group 3 Schools in the first year of testing. The data show that the children were profoundly and prelingually deaf and of slightly above average intelligence. The mean chronological ages of 12.4 years and 12.7 years for the two schools indicated that the subjects in those schools were somewhat younger than the subjects in the other two pairs of schools in the project. This was due to the inclusion of younger children in the population selected from those schools since fingerspelling in the experimental school of the pair begins when the child enters school. A minimum age of nine years was established in the selection of subjects for the study due to the difficulties in administering most of the test materials to deaf children of ages younger than nine.

Table 20 shows the descriptive data for the children in the Group 3 Schools at the beginning of the second year of the project. The data are given because several children were added to the samples from both schools in the second year. They were children who had reached the age of nine years since testing was begun the previous year. They were added to the samples in order to include as many young children as possible

TABLE 18.

EXPERIMENTAL VARIABLES - GROUP 2 SCHOOLS - YEAR 5

	Experimental School (N=21)		Comparison School (N=18)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	88.06	10.91	67.07	17.11	4.56	.001
Speechreading						
Craig Word Test	79.85	10.23	79.12	7.25	0.26	--
Craig Sentence Test	73.96	19.23	73.38	19.86	0.09	--
Speech Intelligibility	30.22	20.41	18.87	12.12	2.02	.05
Stanford Achievement						
Paragraph Meaning	4.93	2.29	4.21	1.48	1.15	--
Word Meaning	4.61	2.39	4.37	1.34	0.39	--
Combined Reading	4.74	2.32	4.26	1.38	0.76	--
Language	5.40	3.05	4.83	3.36	0.52	--
Arithmetic Reasoning	5.84	2.32	4.87	1.77	1.45	--
Arithmetic Computation	6.50	2.27	6.02	1.82	0.73	--
Combined Arithmetic	6.15	2.18	5.42	1.76	1.15	--
Battery Median	5.46	2.27	4.81	1.80	0.98	--
Written Language						
Type Token Ratio	58.75	5.60	56.27	5.39	1.38	--
Grammatical Correctness Ratio	84.80	7.40	79.55	7.99	2.10	.05
Subordination Ratio	14.45	17.83	18.81	23.04	0.66	--
Sentence Length	9.27	5.44	8.89	4.79	0.23	--
Strings Analysis	5.58	2.55	4.46	2.06	1.48	--
"Cloze" Procedures						
Verbatim	25.00	14.13	23.78	13.81	0.27	--
Form Class	68.95	17.26	57.22	16.82	2.12	.05
Verbatim/Form Class	34.30	14.02	39.50	17.96	1.00	--

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TABLE 19.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 1

	Experimental School (N=34)		Comparison School (N=33)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	12.43	2.04	12.68	1.97	0.70	--
IQ	105.41	14.26	105.34	11.48	0.05	--
Time in School (years)	6.93	2.17	7.69	2.66	1.27	--
Hearing Loss in Better Ear (decibels, ASA)	88.89	8.63	88.56	8.12	0.11	--
Age at Onset of Hearing Loss (months)	2.22	6.28	4.00	9.58	1.06	--

TABLE 20.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 2

	Experimental School (N=39)		Comparison School (N=37)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	12.78	2.33	13.69	1.94	1.84	.10
IQ	103.48	13.78	105.44	11.90	0.60	--
Time in School (years)	7.20	2.56	8.61	2.62	2.33	.05
Hearing Loss in Better Ear (decibels, ASA)	86.01	8.90	85.03	7.75	0.52	--
Age at Onset of Hearing Loss (months)	5.54	7.63	4.00	9.58	0.97	--

from schools in which the total populations were quite small. It can be seen from Table 20 that the descriptive data for the children were quite similar to the data obtained in the first year of testing. It will be noted that in the descriptive data presented for both the first and second years of the study in these schools, the children in the comparison school had been in school for approximately one year longer as compared to the children in the experimental school, and the difference was statistically significant in the second year, as shown in Table 20. The difference should be kept in mind in evaluating the experimental results to be presented.

Table 21 shows the experimental results for the first year of the project. There was a statistically significant difference between the two schools on the variable of fingerspelling. However, this was not accompanied by statistically significant differences on any of the other variables with the exception of the language sub-test of the Stanford Achievement Test and the Subordination Ratio. Differences on those variables indicated the experimental subjects had greater mastery of language mechanics and more complex written language structure than the comparison subjects.

Table 22 shows the results for the second year of testing. There was a significant difference between the two schools on the fingerspelling variable, but the only other significant differences were on the word and sentence versions of the Craig Lipreading Inventory where the subjects in the comparison school were superior to those in the experimental school. It will be noted there also was a difference on speech intelligibility in favor of the comparison school which approached statistical significance.

In Table 23 are presented the results for the third year of testing. It can be seen that the significant difference in favor of the experimental school on the fingerspelling variable was accompanied by statistically significant differences in favor of that school on many of the other variables in the study. The subjects in the experimental school were significantly superior to the subjects in the comparison school on the Paragraph Meaning, Word Meaning, and Language sub-tests of the Stanford Achievement Test. They also were significantly superior on the Combined Reading Score and the Battery Median. It will be noted, however, that there were differences in favor of the comparison school on the three measures of lipreading proficiency and the test of speech intelligibility with the difference on the word version of the Craig Lipreading Inventory being statistically significant. There was also a statistically significant difference in favor of the comparison school on the Grammatical Correctness Ratio.

Table 24 shows the results of the fourth year of testing and it can be seen that they were similar to the results for the previous year. The subjects in the experimental school still had significantly higher scores on the fingerspelling variable than the subjects in the comparison school and this was accompanied by significant differences on the Paragraph Meaning and Arithmetic Reasoning sub-tests of the Stanford Achievement Test. The difference between the two schools on the Battery Median was 0.86 grade level which was significant at the .05 percent level of confidence. Differences on the Combined Reading Score and the Combined Arithmetic Score approach statistical significance in favor of the experimental school. It will be noted that the comparison school still had higher

TABLE 21.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 1

	Experimental School (N=34)		Comparison School (N=33)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	69.75	19.76	35.47	31.77	5.12	.001
Speechreading						
Utley Test	5.25	7.71	6.74	8.96	0.73	--
Speech Intelligibility	12.80	10.78	18.14	15.81	1.62	--
Stanford Achievement						
Paragraph Meaning	3.48	0.86	3.22	1.00	1.16	--
Word Meaning	3.10	0.71	3.02	0.69	0.43	--
Combined Reading	3.27	0.70	3.21	0.86	0.32	--
Language	4.21	1.65	2.87	2.21	2.36	.05
Arithmetic Reasoning	3.47	0.95	3.41	1.06	0.25	--
Arithmetic Computation	4.11	0.88	4.03	1.27	0.31	--
Combined Arithmetic	3.80	0.88	3.75	1.14	0.20	--
Battery Median	3.57	0.84	3.33	0.99	1.13	--
Written Language						
Type Token Ratio	50.32	8.03	48.87	14.69	0.46	--
Grammatical Correctness Ratio	80.03	12.67	81.78	11.91	0.61	--
Subordination Ratio	7.93	10.26	0.76	2.50	3.91	.001
Sentence Length	7.01	2.13	6.55	1.60	0.99	--
Strings Analysis	4.09	1.22	4.31	1.70	0.62	--

TABLE 22.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 2

	Experimental School (N=39)		Comparison School (N=37)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	63.07	31.93	47.04	28.77	2.16	.05
Speechreading						
Utley Test	6.93	5.66	9.09	10.76	0.99	--
Craig Word Test	50.89	21.23	66.36	13.73	[illegible].47	.001
Craig Sentence Test	44.70	19.96	61.39	19.01	3.52	.001
Speech Intelligiblity	11.34	9.52	17.15	14.62	1.92	.10
Stanford Achievement						
Paragraph Meaning	3.63	1.23	3.39	0.95	0.91	--
Word Meaning	3.35	1.11	3.21	0.97	0.56	--
Combined Reading	3.52	1.13	3.32	0.94	0.76	--
Language	5.05	2.06	5.01	2.04	0.06	--
Arithmetic Reasoning	3.67	1.44	3.64	1.43	0.09	--
Arithmetic Computation	4.05	1.36	4.43	1.51	1.10	--
Combined Arithmetic	3.89	1.38	4.07	1.45	0.51	--
Battery Median	3.78	1.29	3.66	1.28	0.38	--
Written Language						
Type Token Ratio	52.72	11.96	52.93	8.79	0.08	--
Grammatical Correctness Ratio	80.46	10.55	79.63	16.29	0.25	--
Subordination Ratio	6.60	8.89	3.50	5.15	1.72	.10
Sentence Length	7.73	2.77	7.22	2.67	0.78	--
Strings Analysis	4.46	2.20	4.72	2.68	0.45	--

TABLE 23.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 3

	Experimental School (N=36)		Comparison School (N=37)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	73.39	24.60	48.22	30.15	3.87	.001
Speechreading						
Utley Test	7.85	8.11	10.49	10.72	1.17	--
Craig Word Test	53.60	20.86	66.01	12.88	3.07	.01
Craig Sentence Test	49.33	22.15	57.36	18.55	1.66	--
Speech Intelligibility	13.74	10.29	17.87	16.32	1.31	--
Stanford Achievement						
Paragraph Meaning	4.28	1.54	3.42	1.17	2.69	.01
Word Meaning	3.85	1.42	3.24	0.96	2.16	.05
Combined Reading	4.09	1.40	3.35	1.05	2.56	.02
Language	6.22	2.70	4.59	2.41	2.23	.05
Arithmetic Reasoning	4.52	1.87	3.72	1.77	1.89	.10
Arithmetic Computation	4.98	1.43	4.61	1.57	1.04	--
Combined Arithmetic	4.77	1.60	4.19	1.63	1.54	--
Battery Median	4.60	1.64	3.74	1.39	2.40	.02
Written Language						
Type Token Ratio	52.66	7.74	51.16	6.64	.87	--
Grammatical Correctness Ratio	79.14	9.13	83.72	8.22	2.22	.05
Subordination Ratio	9.75	10.88	6.26	11.60	1.30	--
Sentence Length	8.27	2.48	7.41	2.81	1.36	--
Strings Analysis	4.38	1.86	4.18	1.54	.50	--

scores than the experimental school on the lipreading and speech intelligibility measures with the difference for the word version of the Craig Lipreading Inventory being statistically significant.

Table 25 shows the experimental results for the fifth and final year of testing. The results were similar to those for the third and fourth years of testing.

The results for the five years of testing indicated that the experimental subjects gradually increased their scores on the various sub-tests of the Stanford Achievement Test to the point where they were significantly higher than the scores for the comparison subjects on a number of the sub-tests and on the Battery Median. However, it was also indicated that this significance in educational achievement was accompanied by lower scores for the experimental subjects on speechreading and speech intelligibility than for the comparison subjects. It should be remembered that the comparison subjects were approximately one year older and had been in school about one year longer than the experimental subjects.

Older Children. When the individual data for subjects were examined in the Group 3 Schools in the first year of the study, it was noticed that there appeared to be larger differences in favor of the younger children in the experimental school as compared to those in the comparison school than was true for the older children. In order to examine the possibility of a relationship between the effects of fingerspelling and the age at which its use was begun, the subjects in the Group 3 Schools were divided into two groups after the first year of testing. The first group, which shall be called the older children, consisted of those children who had begun instruction in the experimental school prior to the initiation of fingerspelling in that school and their matched counterparts in the comparison school. The second group of subjects, which shall be called the younger children, consisted of those subjects in the experimental school who had been exposed to the combined use of fingerspelling and speech in the classroom from the time they entered school and their matched counterparts in the comparison school.

Table 26 shows the descriptive data for the older subjects in the first year of testing. The subjects were on the average almost 14 years old, had slightly higher than average intelligence, had been in school an average of between eight and nine years, and were profoundly and prelingually deaf. The groups were matched on these relevant variables although it will be noted that the children in the comparison school had been in attendance in school for 0.77 years longer than the children in the experimental school. While this difference did not reach statistical significance, it nevertheless is a substantial difference which should be taken into account in interpreting the findings.

Table 27 shows the descriptive data for the children in the Group 3 Schools at the beginning of the second year of the project. It will be recalled that additional children at the younger age levels were added in the second year to include as many young children as possible in the study. It can be seen from Table 27 that the older children were still matched in the two schools with no significant differences emerging on any of the descriptive variables.

Table 28 shows the data on the experimental variables for the children in the two schools in the first year of testing. It will be noted that there were few statistically significant differences between the two groups

TABLE 24.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 4

	Experimental School (N=35)		Comparison School (N=31)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	75.78	22.03	56.54	29.14	3.04	.01
Speechreading						
Craig Word Test	55.02	16.19	69.34	12.04	4.05	.001
Craig Sentence Test	50.58	23.41	53.20	21.34	0.46	--
Speech Intelligibility	15.10	8.99	23.39	18.29	1.95	.10
Stanford Achievement						
Paragraph Meaning	4.81	1.83	3.85	1.50	2.32	.05
Word Meaning	4.09	1.57	3.56	1.13	1.55	--
Combined Reading	4.45	1.64	3.72	1.26	1.98	.10
Language	6.52	3.12	5.46	2.05	1.38	--
Arithmetic Reasoning	5.03	1.70	4.05	2.02	2.13	.05
Arithmetic Computation	5.66	1.82	5.06	1.85	1.32	--
Combined Arithmetic	5.39	1.73	4.58	1.90	1.79	.10
Battery Median	5.16	1.75	4.30	1.65	2.04	.05
Written Language						
Type Token Ratio	53.26	8.97	53.39	8.23	0.06	--
Grammatical Correctness Ratio	84.89	8.17	84.37	10.00	0.23	--
Subordination Ratio	13.07	8.81	13.99	13.91	0.24	--
Sentence Length	8.02	2.52	7.89	3.04	0.18	--
Strings Analysis	5.05	2.40	4.99	2.86	0.09	--

TABLE 25.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 5

	Experimental School (N=31)		Comparison School (N=28)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	81.42	18.66	66.22	25.22	2.65	.02
Speechreading						
Craig Word Test	59.53	17.44	71.96	10.84	3.25	.01
Craig Sentence Test	58.32	21.24	64.87	17.31	1.29	--
Speech Intelligibility	17.75	9.24	27.16	20.72	1.97	.10
Stanford Achievement						
Paragraph Meaning	5.30	1.96	4.10	1.41	2.67	.01
Word Meaning	4.53	1.66	3.98	1.53	1.29	--
Combined Reading	4.88	1.75	4.03	1.41	2.06	.05
Language	6.97	3.25	5.76	2.58	1.45	--
Arithmetic Reasoning	5.78	1.79	4.74	2.19	2.00	.05
Arithmetic Computation	6.28	2.17	5.67	1.89	1.14	--
Combined Arithmetic	6.00	1.93	5.18	2.02	1.60	--
Battery Median	5.77	1.92	4.73	1.79	2.16	.05
Written Language						
Type Token Ratio	54.29	9.07	54.07	7.45	.10	--
Grammatical Correctness Ratio	84.97	9.11	83.11	8.93	.79	--
Subordination Ratio	15.48	21.40	5.98	8.01	2.21	.05
Sentence Length	9.23	3.30	8.24	2.89	1.22	--
Strings Analysis	5.53	2.32	5.34	2.80	.28	--
"Cloze" Procedures						
Verbatim	23.33	12.36	25.50	11.51	.62	--
Form Class	63.00	14.18	65.60	13.83	.64	--
Verbatim/Form Class	35.93	17.32	37.75	12.85	.40	--

TABLE 26.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 1
OLDER CHILDREN

	Experimental School (N=22)		Comparison School (N=23)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	13.71	1.18	13.79	1.23	0.34	--
IQ	103.53	14.15	103.74	10.57	0.08	--
Time in School (years)	8.18	1.30	8.95	1.93	1.57	--
Hearing Loss in Better Ear (decibels, ASA)	87.58	9.33	89.66	9.52	1.21	--
Age at Onset of Hearing Loss (months)	3.64	7.64	4.31	7.99	0.54	--

on any of the variables. The exceptions to this were the fingerspelling variable and the Subordination Ratio where the subjects in the experimental school were significantly higher than the subjects in the comparison school. The difference in grade level of 1.01 on the language subtest in favor of the experimental school approached the established level of significance. It will be noted that the children in the comparison school had higher scores than those in the experimental school on the speechreading measure and the test of speech intelligibility; however, neither of these measures reached statistical significance.

Table 29 shows the experimental data for the children in the two schools in the second year of testing. In this year, there were a number of significant differences between the two groups. The subjects in the experimental school had significantly higher scores than the subjects in the comparison school on the variable of fingerspelling and on the Subordination Ratio. It should also be noted that the subjects in the experimental school had higher scores than those in the comparison school on almost all of the sub-tests and combined scores of the Stanford Achievement Test, although none of the differences reached statistical significance. Again, the subjects in the comparison school had significantly higher scores than those in the experimental school on two of the three measures of speechreading ability.

Table 30 shows the data for the subjects in the third year of testing. It can be seen that there were differences in favor of the experimental school on a number of the sub-tests and combined scores of the Stanford Achievement Test. The subjects in the experimental school had significantly higher scores on fingerspelling and on the Paragraph Meaning, the Combined Reading Score, and the Language sub-test of the Stanford Achievement Test. The difference in favor of the experimental school on the Battery Median approached significance. However, the subjects in the comparison school again had higher scores than the subjects in the experimental school on two of the three measures of lipreading ability. It will be noted that the scores on Speech Intelligibility for the two groups were very similar in comparison to the absolute but not statistically significant differences which existed in favor of the comparison school in the previous two years of testing.

The results for the fourth year of testing are shown in Table 31. It should be noted that while the difference between the two groups on the fingerspelling variable was still statistically significant in favor of the experimental school the absolute difference between the two schools was only 11.5 percent and this difference had decreased steadily in each year from the beginning of the study. While the scores for both schools on fingerspelling were increasing, the scores in the comparison school were increasing more rapidly than those in the experimental school indicating the greater influence of manual communication in the more advanced classes in state residential schools. While there still were absolute differences between the two groups on all of the sub-tests of the Stanford Achievement Test and in favor of the experimental school, only the Language sub-test was significantly higher for the experimental school in this fourth year of testing. Again, it will be noted there was a significant difference in favor of the comparison school on one of the measures of speechreading ability and an absolute, although not a statistically significant difference, in favor of that school on the second measure of speechreading ability and on speech intelligibility. There were no significant

TABLE 27.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 2
OLDER CHILDREN

	Experimental School (N=21)		Comparison School (N=21)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	14.70	1.17	14.72	1.12	0.05	--
IQ	103.63	14.48	103.71	10.99	0.04	--
Time in School (years)	9.29	1.30	9.90	1.85	1.34	--
Hearing Loss in Better Ear (decibels, ASA)	87.01	9.34	89.00	6.77	1.12	--
Age at Onset of Hearing Loss (months)	3.60	7.81	4.32	8.14	0.39	--

TABLE 28.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 1
OLDER CHILDREN

	Experimental School (N=22)		Comparison School (N=23)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	76.24	14.24	49.97	26.92	4.06	.001
Speechreading						
Utley Test	7.02	8.49	9.70	9.33	1.00	--
Speech Intelligibility	14.63	11.81	20.86	18.04	1.36	--
Stanford Achievement						
Paragraph Meaning	3.60	0.73	3.59	0.98	0.07	--
Word Meaning	3.24	0.63	3.21	0.70	0.16	--
Combined Reading	3.39	0.58	3.51	0.84	0.58	--
Language	4.13	1.56	3.12	2.13	1.78	.10
Arithmetic Reasoning	3.85	0.73	3.90	0.82	0.25	--
Arithmetic Computation	4.59	0.60	4.63	0.89	0.21	--
Combined Arithmetic	4.21	0.64	4.30	0.81	0.42	--
Battery Median	3.88	0.71	3.69	0.94	0.78	--
Written Language						
Type Token Ratio	51.13	8.34	50.29	20.68	0.16	--
Grammatical Correctness Ratio	80.69	12.03	79.23	14.68	0.34	--
Subordination Ratio	8.80	10.24	0.77	2.65	3.63	.001
Sentence Length	7.05	2.52	5.96	1.25	1.62	--
Strings Analysis	4.04	1.25	3.94	1.56	0.21	--

TABLE 29.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 2
OLDER CHILDREN

	Experimental School (N=21)		Comparison School (N=21)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	78.11	15.48	59.28	24.42	2.87	.01
Speechreading						
Utley Test	6.26	5.20	11.43	12.09	1.72	.10
Craig Word Test	51.67	22.71	68.40	13.13	2.86	.01
Craig Sentence Test	43.73	18.95	67.06	18.39	3.95	.001
Speech Intelligibility	13.38	10.89	17.19	17.54	0.79	--
Stanford Achievement						
Paragraph Meaning	4.05	0.71	3.73	0.87	1.27	--
Word Meaning	3.77	0.94	3.57	0.93	0.68	--
Combined Reading	3.93	0.77	3.67	0.88	0.99	--
Language	5.38	1.81	5.01	2.04	0.58	--
Arithmetic Reasoning	4.62	1.04	4.18	1.31	1.15	--
Arithmetic Computation	4.98	0.86	5.09	1.24	0.31	--
Combined Arithmetic	4.84	0.93	4.67	1.24	0.47	--
Battery Median	4.52	0.87	4.13	1.21	1.15	--
Written Language						
Type Token Ratio	51.07	8.03	56.04	8.15	1.94	.10
Grammatical Correctness Ratio	83.54	8.19	80.98	17.96	0.59	--
Subordination Ratio	10.78	9.90	3.89	5.38	2.79	.01
Sentence Length	8.96	2.84	7.96	2.83	1.13	--
Strings Analysis	5.19	2.27	5.32	2.93	1.63	--

differences between the two groups on any of the measures of written language.

Table 32 shows similar findings for the fifth year of testing. The difference between the two schools on the fingerspelling variable was still statistically significant and was accompanied by significant differences on some other variables. The comparison school had significantly higher scores than the experimental school on the word version of the Craig Lipreading Inventory. There were significant differences in favor of the experimental school on the Paragraph Meaning and Language sub-tests of the Stanford Achievement Test. The difference in grade level in favor of the experimental school in the Battery Median was 1.03 and approached statistical significance.

These results for the older subjects in the Group 3 Schools were similar to the results for the total subjects in the two schools as previously described. However, the differences between the two groups in favor of the experimental school were reduced in comparison to those for the total group. It will be seen in the next section that the largest share of the differences between the two schools for the total subjects was borne by the younger subjects in the experimental school.

Younger Children. Table 33 shows the descriptive data for the younger children in the Group 3 Schools in the first year of testing. The children in the experimental school were exposed to the combined use of speech and fingerspelling from the time they entered the school. The matched subjects in the comparison school all were in oral classes during the first three years of the study. During the last year, some of them were in manual classes. It can be seen that the children were about three and one-half years younger than the children in the older sub-group. The children in this grouping had mean chronological ages of 10.19 and 10.47 in the experimental and comparison schools, respectively. These made them the two youngest groups of children in the survey study. The mean IQ scores for the subjects were 109.08 in the experimental school and 108.80 in the comparison school indicating higher than average intelligence. Both groups of children had been in school for fewer than five years and both groups consisted of profoundly and prelingually deaf children. The groups were matched on the relevant variables with no statistically significant differences on any of the variables.

Table 34 shows the descriptive data for the younger children in the second year of the study. Since splitting the children in these schools into older and younger sub-groups following the first year of testing resulted in only 12 younger subjects in the experimental school and 10 younger subjects in the comparison school, it was decided to add more young subjects in the second year of the study to make the number as large as possible. In that year, all children meeting the established criteria for the study who had attained the age of nine years since the first year of testing were added to the sub-group. This increased the number in the experimental school to 18 and in the comparison school to 16.

It can be seen from Table 34 that there were no significant differences between the two groups of subjects on any of the descriptive variables. However, it will be noted that the subjects in the comparison school were 0.71 years older than those in the experimental school, had a mean IQ of 5.27 points higher, and had been in school for 0.72 years longer at the time of testing. The children in both groups were pro-

TABLE 30.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 3
OLDER CHILDREN

	Experimental School (N=18)		Comparison School (N=21)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	83.21	15.57	66.90	22.09	2.57	.02
Speechreading						
Utley Test	6.42	7.37	15.01	11.34	2.69	.02
Craig Word Test	51.69	22.28	69.47	13.05	3.07	.01
Craig Sentence Test	53.14	21.98	64.08	19.11	1.62	--
Speech Intelligibility	17.13	12.48	17.02	17.39	0.06	--
Stanford Achievement						
Paragraph Meaning	4.90	1.19	4.10	1.04	2.26	.05
Word Meaning	4.19	1.05	3.70	0.96	1.51	--
Combined Reading	4.57	1.00	3.93	0.99	2.02	.05
Language	6.95	2.30	4.96	2.18	2.70	.01
Arithmetic Reasoning	5.41	1.53	4.79	1.51	1.28	--
Arithmetic Computation	5.85	1.24	5.64	1.17	0.54	--
Combined Arithmetic	5.64	1.32	5.24	1.27	0.96	--
Battery Median	5.34	1.35	4.54	1.29	1.89	.10
Written Language						
Type Token Ratio	54.23	5.28	53.12	5.87	0.57	--
Grammatical Correctness Ratio	83.64	5.36	87.12	6.53	1.80	.10
Subordination Ratio	12.06	11.05	7.67	14.65	1.02	--
Sentence Length	8.71	2.40	8.34	3.30	0.40	--
Strings Analysis	5.09	1.86	4.81	1.67	0.48	--

TABLE 31.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 4
OLDER CHILDREN

	Experimental School (N=17)		Comparison School (N=17)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	82.21	11.69	70.72	21.54	2.45	.02
Speechreading						
Craig Word Test	53.78	16.02	71.76	11.53	3.73	.001
Craig Sentence Test	51.23	24.87	63.54	20.11	1.58	--
Speech Intelligibility	15.68	7.42	22.29	18.64	1.15	--
Stanford Achievement						
Paragraph Meaning	5.38	1.60	4.57	1.60	1.50	--
Word Meaning	4.37	1.08	4.05	1.26	0.79	--
Combined Reading	4.85	1.28	4.33	1.37	1.16	--
Language	8.21	2.07	5.72	2.15	3.49	.01
Arithmetic Reasoning	5.82	1.68	5.25	1.69	1.00	--
Arithmetic Computation	6.52	1.79	6.17	1.54	0.62	--
Combined Arithmetic	6.19	1.67	5.74	1.56	0.84	--
Battery Median	5.92	1.36	5.29	1.49	1.30	--
Written Language						
Type Token Ratio	55.61	7.91	54.11	7.07	0.59	--
Grammatical Correctness Ratio	86.39	7.35	85.82	8.50	0.21	--
Subordination Ratio	13.71	9.57	15.81	15.53	0.41	--
Sentence Length	8.54	2.75	9.19	3.31	0.63	--
Strings Analysis	5.57	2.63	6.05	3.35	0.47	--

TABLE 32.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 5
OLDER CHILDREN

	Experimental School (N=16)		Comparison School (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	89.12	8.91	75.77	22.28	2.23	.05
Speechreading						
Craig Word Test	60.23	17.06	72.91	11.14	2.49	.02
Craig Sentence Test	60.41	18.49	72.64	17.19	1.94	.10
Speech Intelligibility	19.21	8.07	24.56	19.24	0.90	--
Stanford Achievement						
Paragraph Meaning	5.98	0.96	4.69	1.42	3.00	.01
Word Meaning	4.68	0.83	4.59	1.66	0.20	--
Combined Reading	5.31	0.79	4.61	1.50	1.63	--
Language	8.77	1.75	6.52	2.54	2.91	.01
Arithmetic Reasoning	6.65	1.65	5.91	2.02	1.13	--
Arithmetic Computation	7.51	1.97	6.74	1.73	1.17	--
Combined Arithmetic	7.06	1.73	6.01	1.84	1.19	--
Battery Median	6.72	1.19	5.69	1.71	1.97	.10
Written Language						
Type Token Ratio	55.94	7.58	56.69	5.66	0.32	--
Grammatical Correctness Ratio	87.25	7.18	86.06	7.55	0.46	--
Subordination Ratio	7.97	9.09	7.08	8.81	0.27	--
Sentence Length	10.70	3.68	8.91	3.36	1.44	--
Strings Analysis	6.03	2.12	6.36	3.23	0.35	--
"Cloze" Procedures						
Verbatim	22.07	16.62	24.92	11.12	0.52	--
Form Class	58.28	17.88	65.54	14.62	1.15	--
Verbatim/Form Class	35.21	23.42	37.31	13.73	0.29	--

foundly and prelingually deaf as indicated by the descriptive data on degree of hearing loss and age at onset of hearing loss.

Table 35 shows the data on the experimental variables for the first year of testing. It will be recalled that there were very few differences on the experimental variables between these two schools in the first year of testing for either the total group of subjects or the older sub-group of subjects. However, it will be noted that there were significant differences between the two groups on a number of the experimental variables for the younger subjects in the first year of testing. The subjects in the experimental school had significantly higher scores than the subjects in the comparison school on the sub-tests of Paragraph Meaning and Language, and higher scores approaching statistical significance on the Combined Reading, Combined Arithmetic and the Battery Median of the Stanford Achievement Test. There were no differences between the two groups on any of the measures of speechreading ability, speech intelligibility, or written language. The large absolute difference between the two groups on the fingerspelling variable should be noted. The mean score for the experimental school for the younger group of subjects was 57.86 percent indicating good ability in reading fingerspelling for such young children. The mean score for the younger subjects in the comparison school was 2.10 percent, indicating that the subjects had practically no ability to read fingerspelling. This would be expected, since the younger subjects in this school were taught only by oral methods and were segregated from manual communication even in the out-of-class environment, to a large extent.

Table 36 shows the experimental data for the two schools in the second year of testing with the N now increased to 18 in the experimental school and to 16 in the comparison school. It should be noted that the mean score on the fingerspelling test for the experimental school decreased from 57.86 to 48.78 percent indicating that the subjects added in the second year had poorer ability than the original subjects in this school in reading fingerspelling. At the same time, the subjects in the comparison school increased their scores on the reading of fingerspelling from 2.0 percent to 18.48 percent. Along with this change from the first to the second year in ability to read fingerspelling, it will be noted that the differences in favor of the experimental school on the various parts and combinations of the Stanford Achievement Test while still substantial in an absolute sense were no longer statistically significant. There was a difference in favor of the experimental school on one of the measures of lipreading ability which approached statistical significance and a statistically significant difference in favor of the comparison school on the measure of speech intelligibility. There were no differences of statistical significance between the two groups on the measures of written language. Essentially, the addition of new and younger subjects in this second year of the study tended to equalize the children in the two schools on the experimental variables.

Table 37 shows the results for the experimental variables in the third year of testing. The subjects in the experimental school had a significantly higher mean score on the fingerspelling variable than the subjects in the comparison school. The mean scores, respectively, are 64.12 and 23.69. The scores indicated good ability on the part of the experimental subjects to read fingerspelling and quite limited ability on the part of the subjects in the comparison school. It can also be seen that the differences

TABLE 33.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 1
YOUNGER CHILDREN

	Experimental School (N=12)		Comparison School (N=10)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	10.19	1.15	10.47	1.24	0.54	--
IQ	109.08	14.31	108.80	13.60	0.05	--
Time in School (years)	4.65	1.45	4.78	1.57	0.20	--
Hearing Loss in Better Ear (decibels, ASA)	87.01	8.27	84.03	9.92	0.39	--
Age at Onset of Hearing Loss (months)	.84	2.60	3.12	5.04	1.41	--

TABLE 34.

DESCRIPTIVE VARIABLES - GROUP 3 SCHOOLS - YEAR 2
YOUNGER CHILDREN

	Experimental School (N=18)		Comparison School (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	10.76	1.21	11.47	1.24	1.51	.10
IQ	103.49	13.43	108.76	13.58	1.03	--
Time in School (years)	5.06	1.60	5.78	1.57	1.17	--
Hearing Loss in Better Ear (decibels, ASA)	90.59	8.24	89.66	9.92	0.27	--
Age at Onset of Hearing Loss (months)	7.73	2.49	3.10	5.04	0.58	--

TABLE 35.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 1
YOUNGER CHILDREN

	Experimental School (N=12)		Comparison School (N=10)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	57.86	23.36	2.10	6.64	7.28	.001
Speechreading						
Utley	2.00	4.78	0.00	0.00	1.32	--
Speech Intelligibility	9.38	7.95	11.88	5.58	0.83	--
Stanford Achievement						
Paragraph Meaning	3.27	1.07	2.38	0.32	2.52	.02
Word Meaning	2.84	0.80	2.61	0.49	0.79	--
Combined Reading	3.08	0.88	2.53	0.35	1.83	.10
Language	5.05	3.04	0.00	0.00	2.35	.05
Arithmetic Reasoning	2.78	0.95	2.26	0.51	1.53	--
Arithmetic Computation	3.23	0.59	2.63	0.82	2.00	.10
Combined Arithmetic	3.03	0.75	2.47	0.64	1.87	.10
Battery Median	2.99	0.77	2.45	0.42	1.97	.10
Written Language						
Type Token Ratio	48.87	7.66	47.43	7.75	0.50	
Grammatical Correctness Ratio	78.77	14.40	84.72	7.37	1.41	--
Subordination Ratio	6.41	10.56	0.71	2.24	1.68	--
Sentence Length	6.93	1.26	7.17	1.72	0.40	--
Strings Analysis	4.18	1.20	4.71	1.80	0.88	--

in favor of the experimental subjects on the ability to read fingerspelling were accompanied by significant differences in favor of those subjects on all sections and combinations of the Stanford Achievement Test. The overall superiority in educational achievement of the experimental subjects was indicated by the difference on the Battery Median of the Stanford Achievement Test, which was 1.06 grade levels in their favor. This was a substantial difference, which with children of this age in schools for the deaf could be considered the equivalent of what is usually obtained in two years of teaching. More importantly, the reading grade level of the experimental subjects was 1.02 higher than that of the comparison subjects. The subjects in the experimental school also had significantly longer Mean Sentence Length than the subjects in the comparison school. There were no statistically significant differences between the groups on any of the measures of lipreading proficiency or speech intelligibility.

The results for the fourth year of testing are shown in Table 38. There still was a highly significant difference statistically in favor of the experimental subjects on the measure of ability to read fingerspelling; however, it will be noted that the mean score on this variable for the comparison subjects had increased to a level of 38.0 percent. The superiority of the subjects in the experimental school on the measure of fingerspelling ability was accompanied by superiority on most of the sub-tests and combination of sub-tests on the Stanford Achievement Test. The Battery Median for the subjects in the experimental school was 4.31 as compared to 3.09 for the subjects in the comparison school. This difference of 1.22 years was more than normally would be achieved by deaf children of this age in two years of teaching. It will be noted that there again were no statistically significant differences between the schools on speechreading proficiency or speech intelligibility. The longer Mean Sentence Length found for the subjects in the experimental school in the previous year of testing was still apparent in the fourth year but did not quite reach the established significance level.

It can be seen from Table 39 that the results for the fifth and final year of testing were a repetition of those for the previous year. The significant difference in fingerspelling in favor of the experimental subjects was accompanied by differences in the same direction on most of the sub-tests of the Stanford Achievement Test. It should be noted that the comparison school had a substantially higher mean score on speech intelligibility than the experimental school. It can also be seen this was true in each year of the study. While the difference did not reach statistical significance in any year, this probably was due to the large standard deviation and the small number of subjects. The absolute size of the difference on speech intelligibility and the consistency of the direction of the difference during the four years of the investigation make it seem likely that the difference was real rather than a chance happening.

The results with the younger subjects in the Group 3 Schools during the five years of testing indicated statistically significant and educationally substantial differences between the two groups in favor of the subjects in the experimental school. In view of the matching of the two groups and the similarities between the two schools in population size, number and type of teachers, curricula, and other pertinent factors it would seem that the only major difference between the two schools which could account for the substantial educational differences was the use of fingerspelling by the experimental subjects. The data for the younger and

TABLE 36.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 2
YOUNGER CHILDREN

	Experimental School (N=18)		Comparison School (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	48.78	37.03	18.48	14.09	2.36	.05
Speechreading						
Utley Test	7.98	6.41	3.64	2.56	1.91	.10
Craig Word Test	50.15	20.28	61.62	14.69	1.52	--
Craig Sentence Test	45.62	21.32	48.15	13.53	0.33	--
Speech Intelligibility	9.08	7.95	17.06	5.38	2.69	.02
Stanford Achievement						
Paragraph Meaning	3.24	1.48	2.59	0.57	1.26	--
Word Meaning	2.96	1.14	2.37	0.37	1.50	--
Combined Reading	3.12	1.29	2.50	0.44	1.39	--
Language	4.29	2.52	0.00	0.00	0.00	--
Arithmetic Reasoning	2.78	1.17	2.38	0.74	0.93	--
Arithmetic Computation	3.17	1.13	2.89	0.76	0.66	--
Combined Arithmetic	3.00	1.11	2.66	0.73	0.84	--
Battery Median	3.08	1.23	2.57	0.57	1.18	--
Written Language						
Type Token Ratio	54.43	15.09	45.91	6.15	1.62	--
Grammatical Correctness Ratio	77.23	11.88	76.59	11.82	0.13	--
Subordination Ratio	2.19	4.87	2.99	4.97	0.40	--
Sentence Length	6.44	2.06	5.48	1.01	1.32	--
Strings Analysis	3.69	1.89	3.33	1.19	0.52	--

TABLE 37.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 3
YOUNGER CHILDREN

	Experimental School (N=18)		Comparison School (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	64.12	28.20	23.69	20.02	4.76	.001
Speechreading						
Utley Test	9.20	8.75	4.55	6.19	1.77	.10
Craig Word Test	55.39	19.89	61.56	11.54	1.09	--
Craig Sentence Test	45.94	22.36	48.56	13.90	0.40	--
Speech Intelligibility	13.01	11.04	19.28	15.74	1.40	--
Stanford Achievement						
Paragraph Meaning	3.66	1.63	2.54	0.58	2.61	.02
Word Meaning	3.52	1.67	2.64	0.53	2.01	.10
Combined Reading	3.62	1.60	2.60	0.52	2.43	.02
Language	5.20	2.96	1.00	1.41	1.93	.10
Arithmetic Reasoning	3.63	1.77	2.31	0.88	2.69	.02
Arithmetic Computation	4.11	1.03	3.26	0.81	2.63	.02
Combined Arithmetic	3.90	1.37	2.81	0.80	2.80	.01
Battery Median	3.85	1.60	2.69	0.59	2.74	.01
Written Language						
Type Token Ratio	50.68	9.54	48.44	6.86	0.78	--
Grammatical Correctness Ratio	75.78	9.74	78.89	8.12	0.99	--
Subordination Ratio	7.45	10.52	4.28	4.75	1.07	--
Sentence Length	7.66	2.49	6.12	1.04	2.23	.05
Strings Analysis	3.78	1.65	3.28	0.64	1.11	--

older subjects along with the data for the total group would indicate that at least in these two schools the use of fingerspelling was more effective at the younger than at the older age levels. This finding is of some significance since the tendency on the part of most schools is to use fingerspelling only when oral methods do not seem to be achieving substantial success in the classroom and then only with children who generally are above the age of 12 years. The data from the present study seem to indicate that greater educational benefits might be obtained by introducing fingerspelling at earlier ages in the school curriculum. It will be recalled, however, that very few if any of the children involved in the present study had been introduced to fingerspelling before the age of six. The data, therefore, do not indicate what results might be achieved by introducing fingerspelling at even earlier ages. This question, however, will be considered in the experimental study where subjects were taught by a combination of speech and fingerspelling from the age of approximately four years.

Analysis of the Measuring Instruments

While most of the measuring instruments used in the project had been used in previous studies involving deaf subjects, data were not available concerning their reliability when used with deaf people. Several analyses were performed to determine the test-retest reliability of the instruments, the intercorrelations of the various tests, and the factors which were being tapped by the instruments.

Stability of the Measuring Instruments

Table 40 shows the reliability coefficients obtained for the tests used in 1964 and 1965. Those years were chosen because all measuring instruments were used in those years with the exception of the "Cloze" procedures which were used only the last year of the study (1967), and because the largest numbers of subjects were tested in 1964 and 1965. The N for the reliability data was 214 subjects.

It can be seen from Table 40 that most of the reliability coefficients were high with the exception of the coefficients for some of the measures of written language. The coefficients for the various subtests and combination measures of the Stanford Achievement Test ranged from .86 for the Language subtest to .95 for the Battery Median. It will be recalled that the same form of the Stanford Achievement Test was used in all five years in which testing was conducted in the survey study. The coefficients of .91 for the fingerspelling test and .81 for the Utley Lipreading Test were high enough to be acceptable. The lower coefficients of .67 for the word version and .60 for the sentence version of the Craig Lipreading Inventory could be due to a lack of stability in the test or to the differential effects of training on lipreading ability of the subjects between 1964 and 1965. This would apply also to the test of speech intelligibility which had a reliability coefficient of .58. With the exception of the coefficient of .70 for the strings analysis, most of the coefficients for the written language measures were only moderate or low. This was particularly true of the Type Token Ratio with a coefficient of .27.

Factor Analysis of the Data

Table 41 shows the intercorrelation of all [illegible] for the year 1964 when the total number of subjects was 223. Table 42 shows the major

TABLE 38.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 4
YOUNGER CHILDREN

	Experimental School (N=18)		Comparison School (N=14)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	66.87	25.76	38.02	27.85	2.99	.01
Speechreading						
Craig Word Test	55.68	16.72	66.21	12.30	1.91	.10
Craig Sentence Test	50.02	22.59	39.74	14.58	1.43	--
Speech Intelligibility	14.40	10.97	24.75	18.53	1.56	--
Stanford Achievement						
Paragraph Meaning	4.21	1.91	2.97	0.73	2.27	.05
Word Meaning	3.79	1.95	2.96	0.49	1.55	--
Combined Reading	4.02	1.90	2.99	0.56	1.96	.10
Language	4.62	3.04	4.38	1.15	0.16	--
Arithmetic Reasoning	4.18	1.31	2.59	1.30	3.39	.01
Arithmetic Computation	4.70	1.33	3.72	1.18	2.11	.05
Combined Arithmetic	4.48	1.32	3.19	1.20	2.79	.01
Battery Median	4.31	1.78	3.09	0.84	2.34	.05
Written Language						
Type Token Ratio	50.76	9.58	52.46	9.78	0.47	--
Grammatical Correctness Ratio	83.29	8.91	82.46	11.76	0.22	--
Subordination Ratio	12.18	8.02	7.93	1.80	0.88	--
Sentence Length	7.46	2.18	6.20	1.48	1.79	.10
Strings Analysis	4.50	2.08	3.61	1.08	1.40	--

TABLE 39.

EXPERIMENTAL VARIABLES - GROUP 3 SCHOOLS - YEAR 5
YOUNGER CHILDREN

	Experimental School (N=15)		Comparison School (N=12)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	73.21	22.84	53.49	23.98	2.18	.05
Speechreading						
Craig Word Test	58.79	18.40	70.71	10.77	1.98	.10
Craig Sentence Test	56.11	24.28	54.51	11.32	0.21	--
Speech Intelligibility	16.00	10.65	30.63	22.95	1.85	--
Stanford Achievement						
Paragraph Meaning	4.57	2.48	3.31	0.97	1.66	--
Word Meaning	4.36	2.25	3.11	0.69	1.77	.10
Combined Reading	4.43	2.33	3.24	0.78	1.68	.10
Language	5.05	3.42	3.72	1.33	0.92	--
Arithmetic Reasoning	4.86	1.47	3.18	1.28	3.12	.01
Arithmetic Computation	4.96	1.52	4.23	0.89	1.46	--
Combined Arithmetic	4.88	1.46	3.68	1.05	2.38	.05
Battery Median	4.76	2.07	3.44	0.84	2.07	.05
Written Language						
Type Token Ratio	52.53	10.41	50.58	8.32	0.53	--
Grammatical Correctness Ratio	82.53	10.51	79.17	9.39	0.87	--
Subordination Ratio	22.52	27.01	4.71	7.11	2.31	.05
Sentence Length	7.67	1.93	7.35	1.92	0.42	--
Strings Analysis	5.00	2.48	3.98	1.19	1.30	--
"Cloze" Procedures						
Verbatim	24.44	7.28	26.57	13.05	.51	--
Form Class	67.13	8.52	65.71	13.34	.31	--
Verbatim/Form Class	36.56	10.17	38.57	12.05	.41	--

TABLE 40.

TEST-RETEST RELIABILITY COEFFICIENTS FOR MEASURING DEVICES USED IN 1964 AND 1965 (N=214)

PM	WM	COMB. READ.	LANG.	AR	AC	COMB. ARITH.	BM	FS	UTLEY LR	CRAIG WORD	CRAIG SENT.	SPEECH	TTR	GCR	MSL	SA	SR
.87	.90	.92	.86	.94	.91	.95	.95	.91	.81	.67	.60	.58	.27	.32	.53	.70	.48

factors which were extracted from this correlation matrix. Table 43 shows the percent of variance in the data accounted for by the various factors. It can be seen that one factor accounted for 40 percent of the total variance and that the remaining variance was distributed among another dozen factors with each having only a small amount of the total variance. The major factor appears to involve symbolic language skills. It will be noted that all subtests of the Stanford Achievement Test loaded heavily on this factor, and it can be seen from Table 42 that the intercorrelations of all subtests of the Stanford Achievement Test were very high. This would indicate that the test was measuring little more than the language ability of the subjects and that the Battery Median for the test could have been predicted accurately from any of the subtests. This has some significance considering the great emphasis which is placed on the Stanford Achievement Test as an indicator of the educational level of deaf children. The total test might be little more than an indicator of their level of language ability.

Of the three lipreading measures, the speech intelligibility measure, and the fingerspelling measure, it can be seen from Table 41 and Table 42 that fingerspelling was the most highly related to measures of symbolic language ability. It was more highly correlated with the subtests of the Stanford Achievement Test and with the measures of written language ability than were the lipreading and speech intelligibility measures. Scores on the fingerspelling test also were correlated .58 with the Utley Lipreading Test, .53 with the word version and .59 with the sentence version of the Craig Lipreading Inventory, and .21 with speech intelligibility. These significant coefficients indicated that there was a positive relationship between fingerspelling and oral communication methods.

THE EXPERIMENTAL STUDY

INTRODUCTION

The second study on the effects of fingerspelling was termed an experimental study because its design permitted better experimental isolation of the independent variable (fingerspelling) than was possible in the survey project. The study had two basic purposes: (1) to examine the effects of the use of fingerspelling when the factors of teacher selection, systematic use of fingerspelling, and the use of fingerspelling in the out-of-class environment were controlled as well as possible; and (2) to examine the effects of fingerspelling on the language and communication development of very young deaf children.

THE SAMPLE

Selection of Schools

Subjects were selected from two residential schools for deaf children. The schools were selected on the basis of these criteria: (1) both schools had large populations of deaf students and large entering classes; (2) each school had a self-contained preschool unit which permitted the entering children to be segregated from the main student population during the four years of the experimental study; and (3) both schools were willing to participate in the project and to permit the investigator control of all factors in the school and dormitory programs relevant to the project.

TABLE 41.

CORRELATION COEFFICIENTS AMONG VARIABLES MEASURED FOR 1964 - ALL SCHOOLS (N =223)

	AGE	IQ	YPS	HL	AGE ONSET	PM	WM	COMB. READ.	LANG.	AR	AC	COMB. ARITH.	BM	FS	UTLEY	CRAIG WORD	CRAIG SENT.	SPEECH	TTR	MSL	GCR	SA
AGE																						
IQ	.37																					
YPS	.86	.31																				
HL	.17	.32	.11																			
AGE ONSET	.01	.01	.01	.04																		
PM	.50	.43	.46	.04	.01																	
WM	.55	.39	.51	.04	.00	.89																
COMB. READ.	.53	.42	.49	.01	.01	.97	.97															
LANG.	.53	.38	.51	.06	.01	.77	.81	.81														
AR	.64	.49	.63	.03	.01	.86	.86	.88	.84													
AC	.70	.44	.67	.05	.01	.79	.83	.83	.82	.93												
COMB. ARITH.	.62	.47	.66	.04	.01	.84	.86	.87	.85	.98	.98											
BM	.56	.46	.58	.09	.01	.91	.91	.93	.89	.96	.91	.95										
FS	.56	.35	.52	.07	.01	.66	.71	.70	.74	.70	.67	.70	.72									
UTLEY	.38	.16	.36	.01	.01	.53	.63	.59	.60	.58	.61	.61	.61	.58								
CRAIG WORD	.39	.24	.35	.01	.01	.38	.41	.41	.34	.36	.41	.39	.38	.53	.54							
CRAIG SENT.	.33	.25	.49	.04	.03	.47	.52	.50	.48	.49	.54	.53	.51	.59	.64	.74						
SPEECH	.17	.12	.11	.09	.02	.32	.32	.33	.27	.28	.28	.29	.30	.21	.46	.43	.42					
TTR	.06	.04	.04	.01	.19	.37	.41	.40	.30	.37	.36	.37	.38	.35	.25	.33	.30	.15				
MSL	.33	.29	.32	.01	.01	.58	.64	.63	.60	.61	.58	.61	.65	.52	.43	.32	.35	.26	.46			
GCR	.18	.21	.12	.01	.01	.57	.58	.59	.48	.52	.53	.54	.55	.55	.35	.50	.43	.28	.65	.56		
SA	.27	.25	.25	.03	.03	.66	.69	.69	.66	.65	.58	.63	.69	.59	.48	.36	.40	.34	.35	.77	.67	
SUB. RATIO	.34	.31	.21	.01	.01	.50	.59	.55	.53	.57	.54	.55	.51	.53	.30	.27	.25	.17	.06	.41	.14	.19

TABLE 42.

VARIMAX ROTATED FACTOR MATRIX
1964 DATA (N=223)

Age	.38	.86	.05	-.05	.01	.08	.07	.09	.06	.04	.07	.05	.08
IQ	.36	.13	.09	-.04	.03	.18	-.04	.89	.04	.02	-.02	.03	.03
YPS	.36	.90	.02	-.01	-.06	.04	-.09	.06	.03	-.04	.04	.03	.02
Hearing Loss	.02	.08	-.02	-.06	.02	.98	.05	.13	-.01	-.02	-.03	-.00	-.00
Paragraph Meaning	.93	.04	.09	.09	.07	.02	-.05	.10	.02	.08	-.01	.02	.02
Word Meaning	.91	.09	.11	.11	.07	.02	-.02	.05	.10	.08	.11	.04	.07
Combined Reading	.94	.06	.10	.10	.08	.03	-.04	.07	.07	.08	.05	.03	.05
Language	.83	.21	.06	.02	.05	-.03	.01	.05	.10	.03	.10	.05	.16
Arith. Reasoning	.92	.20	.06	.08	.06	.02	-.01	.13	.08	.04	.05	.05	.05
Arith. Comp.	.87	.27	.14	.07	.07	-.01	.01	.07	.07	.08	.09	.09	.01
Comb. Arith.	.91	.24	.10	.08	.07	.00	-.00	.10	.07	.06	.07	.07	.03
Battery Median	.95	.15	.09	.08	.06	.01	-.01	.09	.10	.04	.07	.05	.03
Fingerspelling	.63	.18	.26	.10	.00	-.00	-.04	.07	.08	.11	.10	.10	.67
L. R. Utley	.51	.16	.28	.04	.23	-.06	-.02	-.04	.05	-.01	.72	.14	.08
Craig Word	.27	.03	.91	.12	.12	-.03	.00	.08	.05	.11	.11	.11	.08
Craig Sentence	.40	.13	.53	.09	.10	-.01	.04	.05	.02	.05	.17	.68	.10
Speech	.23	-.04	.12	.03	.94	.03	.01	.02	.04	.04	.09	.04	.01
Age at Onset	-.06	-.02	.01	.10	.01	.05	.99	-.03	-.01	.01	-.01	.01	-.01
Type Token Ratio	.30	-.04	.12	.90	.03	-.08	.13	-.04	.12	.16	.02	.04	.04
Mean Sent. Length	.54	.11	.07	.21	.06	-.01	-.02	.07	.77	.10	.04	.01	.05
Gram. Cor. Ratio	.47	-.02	.22	.37	.08	-.03	.02	.03	.13	.73	-.01	.04	.09
Strings Analysis	.61	.02	.09	.07	.12	-.03	-.01	.02	.35	.24	.05	.03	.07
Subord. Ratio	.36	.04	.09	.04	.01	-.01	.02	.04	.18	.14	-.04	-.01	.02

TABLE 43

FACTORS TAPPED BY MEASURING DEVICES

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13
Percent Variance	40.54	8.67	6.56	5.06	4.69	4.67	4.63	4.10	3.72	3.13	2.89	2.42	2.41

TABLE 44.

DESCRIPTIVE VARIABLES

	Experimental Subjects (N=16)		Control Subjects (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Chronological Age (years)	7.81	.40	7.85	0.68	0.34	--
Hearing Loss (decibels, ASA)	100.92	2.13	96.29	2.43	1.21	--
IQ - Leiter (1964)	113.07	27.13	115.43	31.07	0.83	--
IQ - WISC (1968)	100.53	18.66	103.20	21.62	0.75	--
Age at Onset (months)	12.64	8.90	1.79	3.46	4.16	.001

The self-contained preschool units were an essential factor in the design of the study that permitted the investigator to establish a system in the experimental school in which fingerspelling was used systematically with the experimental subjects both in the classroom and in the dormitory programs. Since the dormitory counselors in the experimental school had no knowledge of the language of signs it was relatively easy to provide a communication environment in the dormitories in which speech and fingerspelling were used systematically and from which the language of signs was almost totally excluded. The self-contained preschool unit in the control school permitted an oral program to be in operation for the children at all times both in the classroom and in the dormitory. The study design, therefore, permitted a comparison of the effects produced over a period of four years by the *Rochester Method* and the *Oral Method.*

Selection of Subjects

There were approximately 70 children in the entering class in the experimental school in the fall of 1964. The parents of those children were asked if they would be willing to participate in the experiment by having their children taught in classes by the combined use of speech and fingerspelling. In addition, the parents were informed that they too would have to learn the manual alphabet and use this means of communication with their children as much as possible when the children were at home. All parents of children in the entering class agreed to participate in the project. There were no refusals.

Sixteen children, eight male and eight female, were selected from the entering class of approximately 70. Since testing could not be performed prior to selection of the children, they were selected by school personnel on the basis of seeming to be profoundly and prelingually deaf children of normal intelligence and with no apparent disabilities other than deafness. The testing which was conducted during their first semester in school confirmed the judgments of the school personnel in the selection of the 16 experimental subjects.

When testing had been conducted during the first semester with the 16 experimental subjects, these subjects then were matched individually with 16 subjects from the control school. The results of the matching are shown in Table 44. It can be seen that the two groups were equated on all of the variables with the exception of age at onset of hearing loss, which was 12.64 months for the experimental subjects and 1.79 months for the control subjects. While this difference in age at onset was statistically significant, most persons involved in the education of deaf children likely would agree that it was meaningless in a behavioral sense. All children in the study became deaf prior to the age of two years. It is generally agreed that a child who suffers hearing loss prior to this age has little or no advantage under our present educational provisions over a child who was born deaf.

The data shown in Table 44 were obtained from testing conducted at various times during the period 1964-1968. The mean CA of 7.81 years for the experimental subjects and 7.85 years for the control subjects were the ages of the children in May of 1968. This was close to the end of the fourth academic year in which the children had been in the study. The age of the children at the beginning of the study ranged from approximately 3.5 years to 4.5 years. It thus can be seen that they were very young children at the time the study began and were involved in the study during their early formative school years. The mean hearing loss of the children showed that they were profoundly deaf individuals. The first set of IQ scores shown in Table 44 were obtained on the Leiter International Performance Scale during the first year of the study. The groups were almost identical on that test and were above average in intelligence. The second set of IQ scores was obtained in the last year of the study (1968) on the Performance Scale of the Wechsler Intelligence Scale for Children. It can be seen that the subjects were equated on this test and that the mean IQ's in each school were close to the norm for the general population. The difference of approximately 12 points between IQ on the Leiter International Performance Scale and the WISC is on the same order as that obtained by Oleron in an earlier study of the Leiter administered to deaf children over a period of four years (1963). Since the WISC is the commonly accepted measure of individual intelligence for deaf children in the United States it can be accepted that the two groups of children in the study were of average intelligence. The difference in the age at onset of hearing loss between the two groups has already been discussed and was not considered to be of any psychological significance.

PROCEDURES

The 16 experimental subjects were grouped in two classes of eight. The classes were taught during the four years of the study by teachers who had been trained orally and who had taught by oral methods throughout their teaching careers. However, all teachers who were used with the experimental classes during the four years of the study were persons who were also skilled in the use of fingerspelling. One of the classes had two different teachers during the course of the study and the other class had four teachers during that period of time. A deliberate attempt was made to change teachers for each class almost every year as is the procedure with the general population of deaf children in most schools for the deaf.

The control subjects in the second residential school were instructed only by oral methods throughout the course of the study. They were instructed by teachers who had been orally trained and experienced.

In the experimental school, classes were established to teach fingerspelling to the dormitory personnel and to the parents of the experimental subjects. Since the dormitory personnel in the experimental school were not familiar with the language of signs it was relatively simple to prevent the use of the language of signs within that school. This was a major factor in the selection of the school and a factor which is difficult to replicate in most residential schools for deaf children. Classes in fingerspelling were also established for parents of the experimental subjects in order to encourage the parents to use fingerspelling with their children while the children were at home. By the use of these procedures it was hoped to provide as great an exposure as possible for the experimental subjects in the use of fingerspelling and speech in the classrooms, the dormitories, and the home environment. The children in the control school, on the other hand, were exposed only to oral methods of communication in the classroom, in the dormitories, and in the home environment.

No changes were made in the regular curricula of the two schools nor in the methods of teaching used by the teachers with the experimental and control subjects. The teachers involved in the project were instructed to teach as they always had taught, with the exception that the teachers of the experimental subjects were to use fingerspelling as well as speech at all times with the children. Communication by fingerspelling was to be an exact replication of the communication by speech.

Toward the end of the fourth academic year of the project, a series of experimental tests was administered to all experimental and control subjects. Four areas of performance were assessed: (1) the ability to read fingerspelling from the filmed test of fingerspelling used in the survey project; (2) speechreading ability as assessed by the word and sentence versions of the Craig Lipreading Inventory used in the survey project; (3) reading ability as measured by the Paragraph Meaning, Word Meaning, and Combined Reading scores of the Stanford Achievement Test, the Metropolitan Word Knowledge and Metropolitan Reading Tests, and the Gates Vocabulary and Gates Comprehension Tests; and (4) written language ability. Written language samples were obtained from the subjects by asking them to write "the news." This is a procedure commonly used with deaf children in most schools. The children were asked to write as much news of recent happenings as possible and no time limit was imposed. From the written language productions obtained in this manner a number of measures were obtained: (1) the Total Number of Words produced; (2) the Mean Sentence Length of the productions; (3) the Strings Analysis; (4) the Subordination Ratio; and (5) the Grammatical Correctness Ratio.

All of the experimental tests were administered to the experimental and control subjects during a two-week period in late April and early May of 1968. It will be noted that many of the tests administered were tests which were used in the survey project. An effort was made to use the same tests in both studies to as great an extent as possible. Some changes had to be made, however, primarily because of the young ages of the subjects in the experimental study. Pilot testing indicated that the test of speech intelligibility could not be used reliably with children this young. Also, the written language productions were too short to permit reliable use of the Type Token Ratio which requires a sample of at least 100 words. In order to investigate as intensively as possible the important area of reading, several additional reading tests were added for the children in the experimental study. All tests were administered under conditions similar to those prevailing in the survey study.

The t-test for matched groups was used to assess the significance of differences between the two groups. The .05 level of significance for a two tailed test was established.

RESULTS

The results of the experimental testing are shown in Table 45. Of the 15 assessments made, 10 differences were statistically significant in favor of the experimental subjects, one was significant in favor of the control subjects, and four failed to reach statistical significance. As would be expected, the experimental subjects were significantly superior to the control subjects in their ability to read fingerspelling. In fact, the score of 2.34 percent for the children in the control group indicated almost complete lack of ability to read fingerspelling on the part of those subjects. It should be noted that the test of ability to read fingerspelling which was used required a reading level of at least third grade. This

TABLE 45.

EXPERIMENTAL VARIABLES

	Experimental Subjects (N=16)		Control Subjects (N=16)			
	Mean Score	S.D.	Mean Score	S.D.	t	Level of Significance
Fingerspelling	33.71	21.60	2.34	3.74	8.32	.001
Speechreading						
Craig Word	44.85	16.73	39.79	14.81	1.06	--
Craig Sentence	37.73	12.02	23.21	9.78	3.42	.01
Reading						
SAT Paragraph Meaning	2.28	.53	2.10	.68	1.49	--
SAT Word Meaning	2.31	.50	2.02	.61	2.81	.01
SAT Combined Reading	2.27	.49	2.04	.57	2.19	.05
Metro. Word Knowledge	2.09	.59	1.83	.57	2.69	.02
Metro. Reading	1.96	.54	1.70	.62	3.35	.01
Gates Vocabulary	2.21	.81	1.68	.64	2.55	.02
Gates Comprehension	2.00	.61	1.74	.59	1.57	--
Written Language						
Total Words Written	61.53	29.24	37.47	18.54	2.46	.02
Sentence Length	5.79	1.60	4.49	1.44	3.45	.01
Strings Analysis	3.59	1.16	4.07	1.36	1.52	--
Subordination Ratio	3.23	6.41	2.22	7.61	2.94	.01
Grammatical Correctness Ratio	79.53	19.70	89.33	21.82	2.42	.05

made it a difficult test for children in the experimental group. Observation of the experimental subjects in the classrooms and dormitories indicated that they had greater proficiency in reading fingerspelling than was manifested by their mean score on the test of 33.71 percent. The difficulty of the vocabulary in the test likely was a factor in depressing the scores for the experimental subjects. The test was used with this expectation since no other test was available.

The significantly superior ability in the reading of fingerspelling by the experimental subjects was accompanied by a general superiority on most of the other variables measured in the project. The experimental subjects were significantly superior in their speechreading ability on the sentence version of the Craig Lipreading Inventory and had higher scores than the control subjects on the word version of the Inventory although the difference did not reach statistical significance. The experimental group also was superior to the control group at a statistically significant level on five of the seven measures of reading ability, and had higher scores than the control group on the other two measures of reading ability although the differences did not reach statistical significance.

The experimental subjects were superior to the control subjects at a statistically significant level on three of the five measures of written language ability. The difference between the two groups on the Strings Analysis was not statistically significant and the subjects in the control group had a significant difference in their favor on the Grammatical Correctness Ratio. Examination of the written language productions indicated that the superiority of the control subjects on the Grammatical Correctness Ratio was likely a function of their limited language production. It will be noted that the average Total Number of Words written by the experimental subjects was 61.53 as compared to 37.47 for the control subjects. The significantly higher Subordination Ratio for the experimental subjects and their significantly higher scores on Mean Sentence Length indicated that the experimental subjects tended to write longer and more complex sentences than the control subjects. As well as having a lower total number of words written, the fewer, shorter, and less complex sentences produced by the control subjects reduced their possibilities for grammatical error and was likely the reason for their significantly higher scores on the Grammatical Correctness Ratio.

It thus can be seen from the results of the four years of the project that the experimental subjects were superior in their ability to read fingerspelling. The superiority was accompanied by a general superiority in language and communication as measured in the study. The experimental subjects had superior speechreading ability, superior reading ability, and superior ability in written language as compared to the control subjects. It should be noted, however, that most of the differences between the two groups, while statistically significant, were not large in an absolute sense. This same factor was noted in the survey project and will be discussed in more detail in the section dealing with interpretations of the investigations.

SUMMARY AND IMPLICATIONS

The purpose of this investigation was to examine the effects of the use of combined speech and fingerspelling (the *Rochester Method*) on the development of language, communication, and educational achievement in profoundly and prelingually deaf students. The procedures for examination of the problem involved two studies: (1) a survey study of six residential schools for deaf children and youth; (2) an experimental study in two residential schools.

Summary of the Survey Study

The survey study involved more than 200 subjects from six residential schools for deaf children and youth, three of which were designated as experimental schools and three as comparison schools. The experimental schools used a combination of speech and fingerspelling within the classroom with the subjects selected for the project. In the comparison schools, the various combinations of oral and manual communication methods known as the *Combined System* were used. This is the system typically used in most residential schools for deaf children. The project was termed a survey project because no intervention was made in the programs of the schools. The investigator simply administered a battery of tests to the subjects in the schools each year for five years and made comparisons between the performances of the subjects in the experimental and comparison schools. Comparisons were made between (1) the performances of the subjects in the three experimental schools combined and the performances of the subjects in the three comparison schools combined, and (2) the performances of the subjects in each of the three experimental schools and the performances of the subjects in the matched comparison school of each pair.

The Combined Schools

Matching of subjects between the experimental and comparison schools was successfully accomplished. A battery of experimental tests was then administered to all subjects in the initial year of the project and in each of the succeeding four years. In terms of the hypotheses stated in an earlier section of the report the following results were obtained.

1. Statistically significant differences emerged in favor of the experimental group in each year of the project on the ability to read fingerspelling.
2. There were consistent and statistically significant differences in favor of the experimental group on most of the measures of educational achievement, including reading ability, in most of the years of the project.
3. There were statistically significant differences in favor of the experimental group in most of the years of the project on a number of measures of written language ability.
4. No consistent differences of a statistically significant level were found between the experimental and comparison groups on the measures of speechreading ability.
5. No consistent differences of a statistically significant level were

found between the two groups on the measure of speech intelligibility.

In general, the experimental group was significantly superior to the comparison group on measures involving meaningful language. There were no significant differences between the two groups on the various measures of oral skills—speechreading ability and speech intelligibility.

The Paired Schools

The design of the survey involved three sets of paired schools with one member of each pair being an experimental school in which the subjects were exposed systematically to the use of fingerspelling and speech in the classroom, and the other a comparison school in which oral and some combinations of manual methods were used. The pairs were designated as Group 1 Schools, Group 2 Schools, and Group 3 Schools.

Group 1 Schools. In Group 1 Schools, the experimental member of the pair had an educational program which introduced the combined use of fingerspelling and speech as the classroom communication method with all children when they reached the Intermediate Department which was usually at about the age of 12 or 13 years. Subjects meeting the criteria for the study were selected from those who began the use of that method in the year the study was initiated and they were matched with subjects in the comparison school. The experimental tests were administered each year throughout the four years of the study.

In this particular pair of schools, only a few significant differences emerged on the experimental variables during the course of the study. In general, it can be said that the two schools were equivalent, in fact almost identical, on all experimental variables except speechreading at the initiation of the study. During the next four years while fingerspelling was systematically used in the classroom in the experimental school, some differences did emerge in favor of this school, and by the final year of testing a number of the differences approached statistical significance. Examination of the data showed that the two schools never differed significantly on the fingerspelling variable so that a true experimental situation did not exist. Several possible reasons were advanced to explain the lack of difference between the two groups of subjects in their ability to read fingerspelling. Observation indicated that there likely was considerable use of fingerspelling in the classroom in the comparison school.

Group 2 Schools. In the second pair of schools, instruction in the experimental member involved the combined use of speech and fingerspelling for all children when they reached the level of the Intermediate Department. Subjects were selected from the entering class in the Intermediate Department at the initiation of the study and they were matched with subjects in the comparison school.

The performances of the subjects in the two schools were similar on most of the experimental variables in the initial year of testing. During the subsequent four years of testing, the subjects in the experimental school achieved increasingly superior scores for two years on most of the experimental variables with a decline in the last two years which was apparently due to unavoidable loss of subjects in both schools.

Group 3 Schools. Instruction through the combined use of fingerspelling and speech begins in the experimental school of this pair from the time the child enters school. Children meeting the criteria for the study were selected as subjects from the school provided they had reached the age of nine years at the initiation of the project. During the second year of the study, additional subjects were added who had reached the age of nine in order to increase the number of young children in the investigation. All subjects selected in the experimental school were matched with subjects in the comparison school. Three types of analysis were made of the data: (1) comparisons between the two schools for the total number of subjects; (2) comparisons of the older children within the total sample who had been in school prior to the time the *Rochester Method* was initiated in the experimental school; and (3) comparisons of the younger subjects in the total sample who had begun school after the *Rochester Method* was initiated in the experimental school.

The results for the total number of subjects showed that the experimental subjects gradually increased their scores on various sub-tests of the Stanford Achievement Test to the point where they were significantly higher than the scores for the comparison subjects on a number of the sub-tests and on the Battery Median of the test. No consistent differences were found between the two groups on the measures of written language ability. The subjects in the comparison school had consistently higher scores than the experimental subjects on speechreading and speech intelligibility, with the differences in speechreading being statistically significant in some instances.

The results for the older subjects were similar to the results for the total group. However, the differences between the two groups in favor of the experimental school were reduced in comparison to the results for the total number of subjects.

The results with the younger subjects in the Group 3 Schools indicated statistically significant and educationally substantial differences between the two groups in favor of the subjects in the experimental school. The differences were most apparent on the various sub-tests and combined scores of the Stanford Achievement Test. However, there also were a few differences on the measures of written language ability. No statistically significant differences emerged between the groups on the measures of speechreading ability and speech intelligibility.

Summary of the Experimental Study

The experimental study was considered to be the more important of the two studies although it was much smaller in scope than the survey project. Its importance was due to the fact that all essential elements were under control of the investigator: the selection of subjects, the selection of teachers to use the *Rochester Method,* and structuring of the out-of-class environment. With these elements under control it was possible to make a comparison of the results obtained with young deaf children through the use of the *Oral Method* and the *Rochester Method.* The study also permitted examination of the effects of fingerspelling on very young deaf children since the subjects in the study ranged from three and a half to four and a half years of age at the time the study began.

The experimental study involved use of the *Rochester Method* with 16 selected deaf children in a residential school, use of the *Oral Method* with 16 matched deaf children in a comparable residential school, control of the classroom and out-of-class environments of both groups of children for a period of four years, and comparison of the two groups in the final year of the project on a number of measures of language and communication development to determine the comparative effects of the two methods.

In terms of the hypotheses stated in an earlier section of the report the following results were obtained.

1. The experimental group had a significantly higher mean score than the comparison group on the test of ability to read fingerspelling.
2. The experimental group had significantly higher mean scores than the comparison group on five of the seven measures of reading ability. The experimental group also had higher mean scores on the other two measures but the differences did not reach statistical significance.
3. The experimental group had significantly higher mean scores than the comparison group on three of the five measures of written language ability. The comparison group was superior on one of the measures and there was no significant difference between the two groups on the remaining measure of written language ability.
4. The experimental group had a significantly higher mean score than the comparison group on one of the two measures of speechreading ability. The experimental group also had a higher mean score on the second measure of speechreading ability, but the difference did not reach statistical significance.

The data from the experimental study showed consistent and significant superiority of the experimental group on almost all of the measures used in the study. Not only did the experimental subjects exceed the comparison group on reading and written language ability, they also exhibited superiority in the measures of speechreading ability. It can be concluded that better results were achieved by the *Rochester Method* than by the *Oral Method* for the particular children and schools involved in the investigation.

Implications of the Studies

Even when the statement of a problem and the procedures used to examine it are generally accepted, differences can arise in the interpretation of the results obtained in an investigation. This likely will be true of the present studies. Therefore, it should be noted that the implications presented in this section are those of the author alone and are based on evaluation of the present studies, other studies of the problem as reviewed in the report, and observation in the project schools throughout the conduct of the investigations.

The results of the study would seem to indicate that the use of fingerspelling in combination with speech can lead to improvements in the achievement of deaf children on those variables in which meaningful language is involved. The results also indicate that oral skills, at the level which they now are achieved by deaf students in most schools, need not be harmed by the use of fingerspelling. The lack of consistent patterns in the oral ability of subjects in the survey study indicate that the level of oral skills is dependent upon the quality of instruction in particular schools rather than upon the method of communication which is used. This interpretation is reinforced by the performance of the subjects in the experimental study where the students taught by the *Rochester Method* were superior in speechreading ability to the subjects taught by the *Oral Method.*

The findings of the survey study and the experimental study indicate that greater gains in achievement can be obtained by the use of fingerspelling with younger rather than with older children. This is the reverse of the process usually employed in most residential schools where manual communication is not introduced in the classroom until children have been exposed for several years to the *Oral Method.* The interpretation is reinforced by other information in the literature on this problem (Meadow, 1967).

While the use of fingerspelling in the present studies produced statistically significant gains for the experimental subjects on a number of variables, the differences between the experimental and comparison groups usually were not large in an absolute sense. In the survey study, the superiority attained by the experimental groups on the Battery Median of the Stanford Achievement Test rarely exceeded one grade. Differences on reading and written language ability also were not large even when statistically significant. The same statements can be made about the findings of the studies by Quigley and Frisina (1961), Stuckless and Birch (1966), and Meadow (1967). Also, while the differences between the mean scores of the experimental and comparison groups in the present studies were often statistically significant, the size of the standard deviations indicate that there was considerable overlap between the distributions of the scores of the two groups. This means that some of the comparison subjects performed better than some of the experimental subjects and indicates a differential effect of the method of communication with particular subjects. This is a factor which requires further investigation.

The size of the absolute differences between the experimental and comparison groups must be evaluated in terms of the relatively low achievement of deaf students in general. As pointed out in the review of the literature on this matter, an advance of one grade level in educational achievement or reading ability is educationally substantial for deaf students and represents what is usually achieved by two or three years of teaching in most schools with present methods of instruction. Such a difference is worthy of consideration. It would seem, then, that while the use of fingerspelling does not provide any panacea in the education of deaf children it can, in combination with good oral techniques, be a useful tool in helping develop language and communication.

On the basis of these interpretations the following implications can be drawn from the findings of the studies.

1. The use of fingerspelling in combination with speech as practiced in the *Rochester Method* can lead to improved achievement in deaf students, particularly on those variables where meaningful language is involved.
2. When good oral techniques are used in conjunction with fingerspelling, there need be no detrimental effects to the acquisition of oral skills.
3. Fingerspelling is likely to produce greater benefits when used with younger rather than with older children. It was used successfully in the experimental study with children as young as three and a half years of age.

4. Fingerspelling is a useful tool for instructing deaf children but is not a panacea.

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APPENDIX A

TABLE A.

DESCRIPTIVE VARIABLES - SCHOOLS DROPPED FROM THE STUDY

YEAR 1

	Comparison School Group 1 (N=38)		Comparison School Group 2 (N=36)		Comparison School Group 3 (N=33)	
	Mean Score	S.D.	Mean Score	S.D.	Mean Score	S.D.
Chronological Age (years)	13.1	1.82	13.0	1.99	12.6	2.22
IQ	104.4	12.30	108.4	10.90	102.2	11.70
Time in School (years)	7.5	1.85	7.9	2.34	5.5	2.45
Hearing Loss in Better Ear (decibels, ASA)	89.7	9.26	92.8	5.58	90.9	9.86
Age at Onset of Hearing Loss (months)	9.5	8.56	7.1	7.32	7.9	6.91

YEAR 2

					(N=42)	
Chronological Age (years)					12.6	2.79
IQ					102.1	12.00
Time in School (years)					5.7	2.84
Hearing Loss in Better Ear (decibels, ASA)					91.3	8.86
Age at Onset of Hearing Loss (months)					5.7	7.42

TABLE B.

EXPERIMENTAL VARIABLES - SCHOOLS DROPPED FROM THE STUDY - YEAR 1

	Comparison School Group 1 (N=38)		Comparison School Group 2 (N=36)		Comparison School Group 3 (N=33)	
	Mean Score	S.D.	Mean Score	S.D.	Mean Score	S.D.
Fingerspelling	53.12	28.48	41.42	26.73	46.50	31.93
Speechreading						
Utley Test	8.76	8.67	11.22	9.26	6.91	11.93
Speech Intelligibility	11.25	10.01	22.11	17.50	13.95	15.46
Stanford Achievement						
Paragraph Meaning	3.40	1.00	3.92	1.31	3.12	1.02
Word Meaning	3.13	0.95	3.49	1.10	2.93	0.87
Combined Reading	3.29	0.92	3.73	1.17	3.06	0.90
Language	5.10	2.29	5.87	2.13	3.85	2.43
Arithmetic Reasoning	3.64	1.77	4.36	1.84	3.25	1.42
Arithmetic Computation	4.76	1.69	4.70	1.66	4.01	1.31
Combined Arithmetic	4.26	1.68	4.58	1.75	3.64	1.34
Battery Median	3.78	1.50	4.29	1.61	3.30	1.25
Written Language*						

*Since written language for the total project was analyzed in the final year, compositions were not analyzed for the three comparison schools which had been dropped from the study.

TABLE C.

EXPERIMENTAL VARIABLES - SCHOOLS DROPPED FROM THE STUDY - YEAR 2

	Comparison School Group 1 (N=36)		Comparison School Group 2 (N=36)		Comparison School Group 3 (N=42)	
	Mean Score	S.D.	Mean Score	S.D.	Mean Score	S.D.
Fingerspelling	62.81	24.96	53.54	29.40	40.98	32.72
Speechreading						
Utley Test	8.16	7.36	18.23	13.86	7.34	10.09
Craig Word Test	56.20	21.73	69.50	14.54	42.22	24.78
Craig Sentence Test	57.71	23.62	64.24	21.61	42.03	21.67
Speech Intelligibility	12.79	12.43	29.18	17.49	16.95	14.24
Stanford Achievement						
Paragraph Meaning	4.04	1.41	4.18	1.43	3.42	1.36
Word Meaning	3.64	1.02	3.96	1.29	3.39	1.24
Combined Reading	3.87	1.17	4.09	1.32	3.43	1.27
Language	5.21	2.90	5.39	2.56	3.61	3.51
Arithmetic Reasoning	4.29	1.83	4.87	1.96	3.70	2.37
Arithmetic Computation	5.19	1.62	5.32	1.85	4.27	1.77
Combined Arithmetic	4.76	1.68	5.12	1.89	4.01	1.98
Battery Median	4.38	1.71	4.78	1.86	3.74	1.81
Written Language*						

*Since written language for the total project was analyzed in the final year, compositions were not analyzed for the three comparison schools which had been dropped from the study.

TABLE D.

EXPERIMENTAL VARIABLES - SCHOOLS DROPPED FROM THE STUDY - YEAR 3

	Comparison School Group 1 (N=34)		Comparison School Group 2 (N=36)		Comparison School Group 3 (N=36)	
	Mean Score	S.D.	Mean Score	S.D.	Mean Score	S.D.
Fingerspelling	71.56	21.12	67.04	20.51	56.30	27.32
Speechreading						
Utley Test	12.86	11.58	19.04	13.23	7.44	9.41
Craig Word Test	57.41	20.87	73.26	13.34	59.63	18.36
Craig Sentence Test	58.09	23.69	76.11	23.70	50.24	20.93
Speech Intelligibility	14.61	13.27	33.26	24.19	17.82	15.47
Stanford Achievement						
Paragraph Meaning	4.26	1.29	4.39	1.51	3.65	1.28
Word Meaning	3.94	1.28	4.05	1.48	3.89	1.69
Combined Reading	4.13	1.25	4.22	1.40	3.79	1.41
Language	6.30	2.92	5.73	2.51	4.30	3.44
Arithmetic Reasoning	4.78	2.25	5.36	2.09	4.21	2.24
Arithmetic Computation	5.79	2.23	5.82	2.06	4.96	1.92
Combined Arithmetic	5.33	2.21	5.61	2.04	4.57	2.01
Battery Median	5.57	4.81	5.11	2.00	4.24	1.94
Written Language*						

*Since written language for the total project was analyzed in the final year, compositions were not analyzed for the three comparison schools which had been dropped from the study.